Macintosh® SE
Owner's Guide

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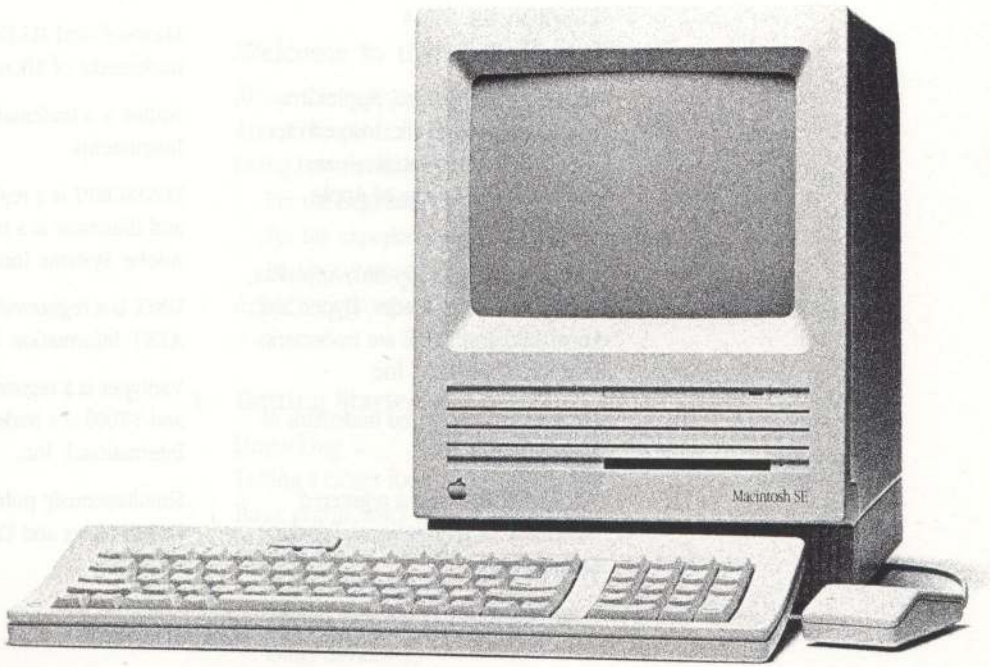
This equipment has been certified to comply with the limits for a Class B computing device pursuant to Subpart J of Part 15 of FCC rules. Only peripheral devices (computer input/output devices, terminals, printers, and so on) certified to comply with Class B limits may be attached to this computer.

Operation with noncertified peripheral devices is likely to result in interference to radio and television reception.

Macintosh® SE
Owner's Guide



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Radio and television interference

The equipment described in this manual generates and uses radio-frequency energy. If it is not installed and used properly—that is, in strict accordance with our instructions—it may cause interference with radio and television reception.

This equipment has been tested and complies with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules. These rules are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that the interference will not occur in a particular installation, especially if a "rabbit-ear" television antenna is used. (A rabbit-ear antenna is the telescoping-rod type usually found on television receivers.)

You can determine whether your computer is causing interference by turning it off. If the interference stops, it was probably caused by the computer or its peripheral devices. To further isolate the problem, disconnect the peripheral devices and their input/output (I/O) cables one at a time. If the interference stops, it was caused by either the peripheral device or the I/O cable. These devices require shielded I/O cables. For Apple peripheral devices, you can obtain the proper **shielded cable** from your authorized Apple dealer. For non-Apple peripheral devices, contact the manufacturer or dealer for assistance.

A **shielded cable** has a metallic wrap around the wires to reduce the potential effects of radio-frequency interference.

If your computer does cause interference to radio or television reception, you can try to correct the interference by using one or more of the following measures:

- Turn the television or radio antenna until the interference stops.
- Move the computer to one side or the other of the television or radio.
- Move the computer farther away from the television or radio.
- Plug the computer into an outlet that is on a different circuit than the television or radio. (That is, make certain the computer and the radio or television set are on circuits controlled by different circuit breakers or fuses.)
- Consider installing a rooftop television antenna with a coaxial cable lead-in between the antenna and television set.

If necessary, consult your authorized Apple dealer or an experienced radio/television technician for additional suggestions.

△ Important This product was FCC-certified under test conditions that included use of shielded cables and connectors between system components. It is important that you use shielded cables and connectors to reduce the possibility of causing interference to radio, television, and other electronic devices. △

Welcome to the Macintosh SE

THIS MANUAL TEACHES YOU ABOUT THE APPLE® MACINTOSH® SE COMPUTER. The Macintosh SE embodies the same "user-friendly" philosophy as the original Macintosh, while providing more memory, faster performance, greater expandability, and more sophisticated system software. The Macintosh is still easy to learn and use, and more powerful than ever.

About this manual

Here's what you'll find in this manual:

- Chapter 1, "Getting Started," shows you how to set up your Macintosh SE and how to start the training disk, *Your Apple Tour of the Macintosh SE.*
- Chapter 2, "Inside the Macintosh SE," describes the parts of the Macintosh SE and what they do.
- Chapter 3, "How the Macintosh SE Works," explains how the computer hardware and software work together.
- Chapter 4, "Macintosh SE Ports and Buses," explains the different ports and buses you'll use to attach devices to your Macintosh SE.
- Chapter 5, "Caring for Your Macintosh SE," describes how to keep your computer running at peak efficiency.
- Appendix A, "The Macintosh Product Line," is a chart that summarizes the differences between the Macintosh SE and other models of Macintosh computers.
- Appendix B, "Technical Information," provides specifications, Apple Desktop Bus power requirements, SIMM configurations, pin assignments, and a guide to peripheral device cables.
- Appendix C, "Connecting SCSI Devices," presents information you may need if you plan to attach SCSI devices to your computer system.
- Appendix D, "Guide to Technical Documentation," summarizes the technical documentation available for Macintosh computers and explains some resources available for Macintosh programmers and developers.

You'll find a glossary of Macintosh terms and an index at the end of the manual. Inside the back cover, you'll also find a Tell Apple card. After you've spent some time with your computer, be sure to fill out the card and send it in. We want to know what you think about Apple products and training materials.

△ Important After using Chapter 1 to set up your Macintosh SE, you can put this manual aside and go on to other learning materials. Read the rest of this manual if you're curious about how the computer works, or use it for reference. △

About the other manuals

Besides the book you're reading, your Macintosh SE came with some other manuals. *You won't have to read them all to learn how to use your computer.* They're there to give you information when you need it, but you'll quickly be up to speed with very little "required reading." Here's what the other books are for:

- *Macintosh System Software User's Guide:* This is the manual that explains how to use the *Macintosh System Tools* and *Macintosh Printing Tools* disks that came packed with your computer. After you've set up your computer, this is also the manual you'll use to learn basic Macintosh techniques—the same techniques you'll use whenever you operate the computer. It also teaches you about the Macintosh Finder™—an important application program you'll use whenever you work with your Macintosh SE.
- *Macintosh Utilities User's Guide:* This is the manual that explains how to use the *Macintosh Utilities* disks, which contain special programs you'll use occasionally to customize your system to your specific needs, and to update it and keep it running efficiently.
- *HyperCard User's Guide:* This manual explains an exciting new software product—HyperCard™—that's included free with your Macintosh SE. HyperCard is a personal toolkit for using, customizing, and creating information. You'll want to read the *HyperCard User's Guide* only after you've become familiar with the Macintosh SE.

Using the manuals

You can use these manuals in a variety of ways, depending on your level of computer experience. The following sections suggest approaches to learning about your Macintosh SE.

For the beginner

If your computer is already set up, you're ready to turn to the training disk or tutorial.

If you've never used a Macintosh computer before, follow these steps:

1. Use the instructions in Chapter 1 of this manual to set up your Macintosh SE.
2. Follow the instructions in Chapter 1 to start the training disk, *Your Apple Tour of the Macintosh SE,* or go through the tutorial in the *Macintosh System Software User's Guide* to learn basic Macintosh skills. (You may want to use both the training disk and the tutorial; it's up to you.)
3. If your computer includes an internal hard disk, see the instructions in the *Macintosh System Software User's Guide* to prepare the hard disk for use.
4. If you have other devices to attach to your computer, turn to the manuals that came with those devices for instructions on connecting them correctly.
5. Look through the manuals that came with the application programs you'll be using with your computer.

Return to this book if you have questions about the Macintosh SE or how to care for it. Refer to the *Macintosh System Software User's Guide* for information about Macintosh system software or help in troubleshooting any problems you encounter. Use the *Macintosh Utilities User's Guide* when you need instructions for using utility programs.

For the experienced user

Even though this manual is written primarily for newcomers to the Macintosh computer, you'll probably want to read the following:

1. Read Chapter 1 for instructions on setting up your computer—even if you've already had experience using a Macintosh. The Macintosh SE looks a lot like earlier Macintosh computers, but you attach some devices differently.
2. If your computer includes an internal hard disk, follow the instructions in the *Macintosh System Software User's Guide* to prepare the hard disk for use.
3. See Appendix A, "The Macintosh Product Line," for a quick guide to how the Macintosh SE differs from other models of Macintosh computers.
4. Use the *Macintosh System Software User's Guide* to learn about the new features of Macintosh system software with which you may be unfamiliar.
5. Use the *Macintosh Utilities User's Guide* to learn about utilities that may be new to you.

If you're interested in learning more about the Macintosh SE, read Chapter 2, "Inside the Macintosh SE," Chapter 3, "How the Macintosh SE Works," and Chapter 4, "Macintosh SE Ports and Buses."

For the advanced user

If you're looking for technical information about the Macintosh SE, the appendixes may contain what you need:

- Use Appendix A to determine how the Macintosh SE differs from other Macintosh models you may be familiar with.
- Look in Appendix B for specifications, Apple Desktop Bus power requirements, SIMM configurations, and other technical information.
- Read Appendix C if you need information about connecting SCSI devices to your computer.
- If none of the appendixes has what you're looking for, refer to Appendix D, "Guide to Technical Documentation"; it will lead you to the appropriate technical manuals. (Appendix D also provides information that may be useful if you're a programmer or developer.)

Apple user groups

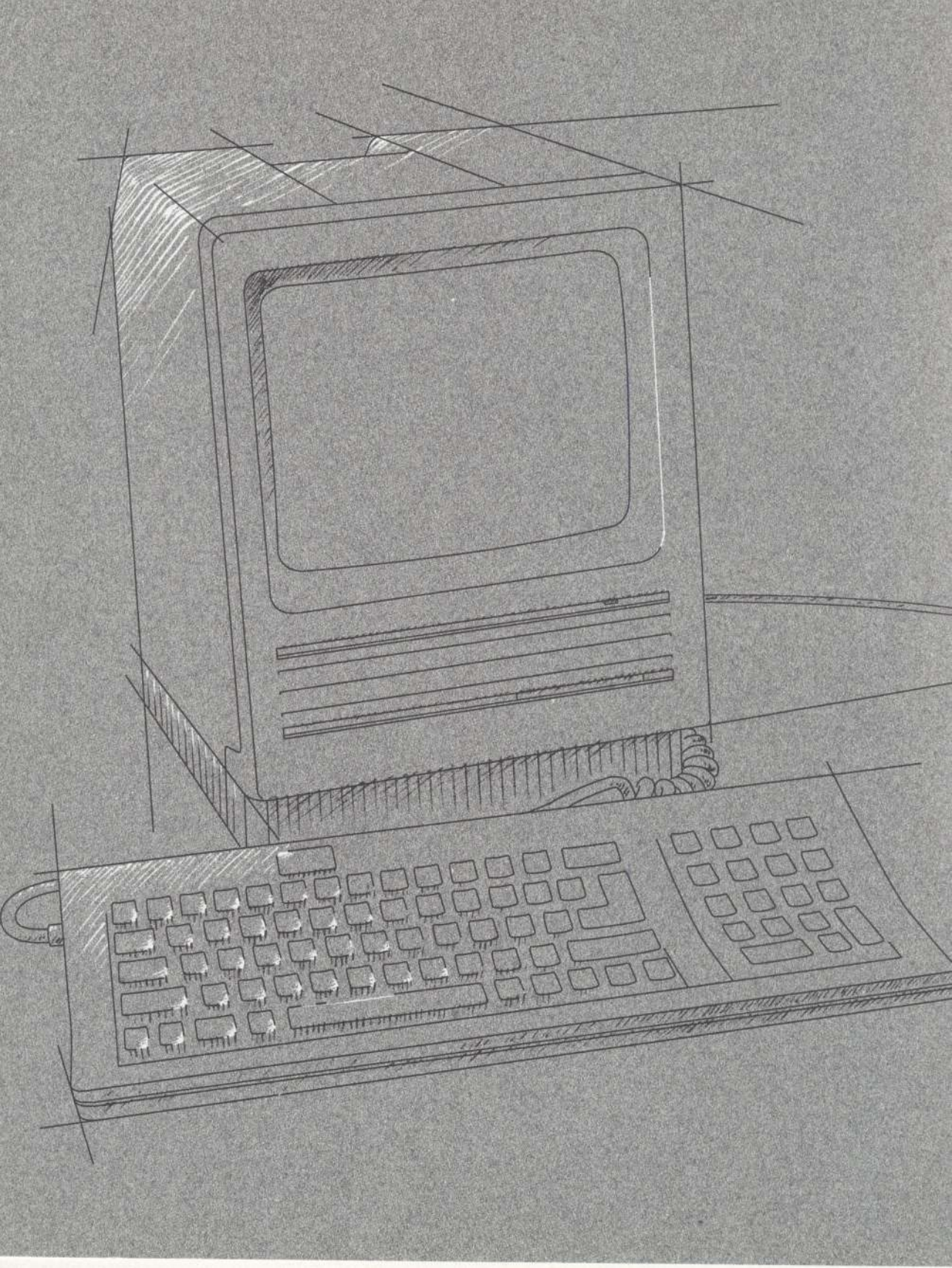
No matter what your level of computer experience, you can get lots of support by joining an Apple user group. Apple user groups are composed of people who work with Apple computers and who enjoy sharing what they know with others. Activities may include new product demonstrations, informal question-and-answer sessions, and regular classes on using popular software applications or learning to write your own programs. Many user groups have special beginners' nights.

Ask your authorized Apple dealer for the name of the Apple user group nearest you, or call 1-800-538-9696. For user groups outside the United States, or if you are interested in starting your own user group, contact either

The Boston Computer Society
One Center Plaza
Boston, MA 02108
(617) 367-8080

or

Berkeley Macintosh User Group
1442-A Walnut Street #62
Berkeley, CA 94709
(415) 849-9114



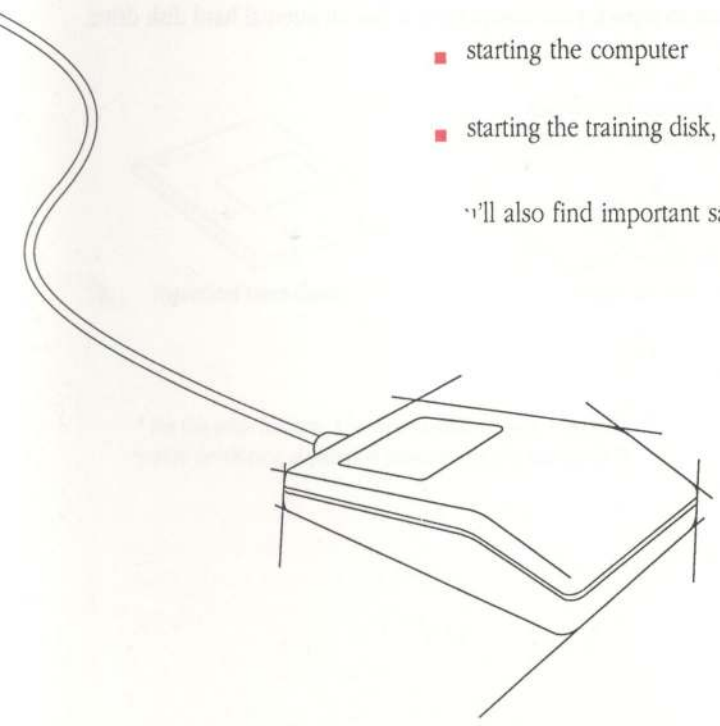
CHAPTER 1

Getting Started

THIS CHAPTER WILL HELP YOU GET STARTED WITH YOUR MACINTOSH® SE computer. You'll find instructions for

- unpacking the equipment
- setting up the Macintosh SE
- starting the computer
- starting the training disk, *Your Apple Tour of the Macintosh SE*

You'll also find important safety instructions.



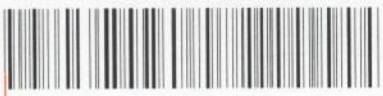
Unpacking and setting up your Macintosh SE is easy and takes only a few minutes. If somebody has already set up your computer for you, you can skip most of this chapter; go directly to the "Important Safety Instructions" section and continue on from there.

Unpacking

The first thing to do is make sure you have everything you're supposed to. Take all the materials out of the packing boxes and see if you have everything shown on the opposite page.

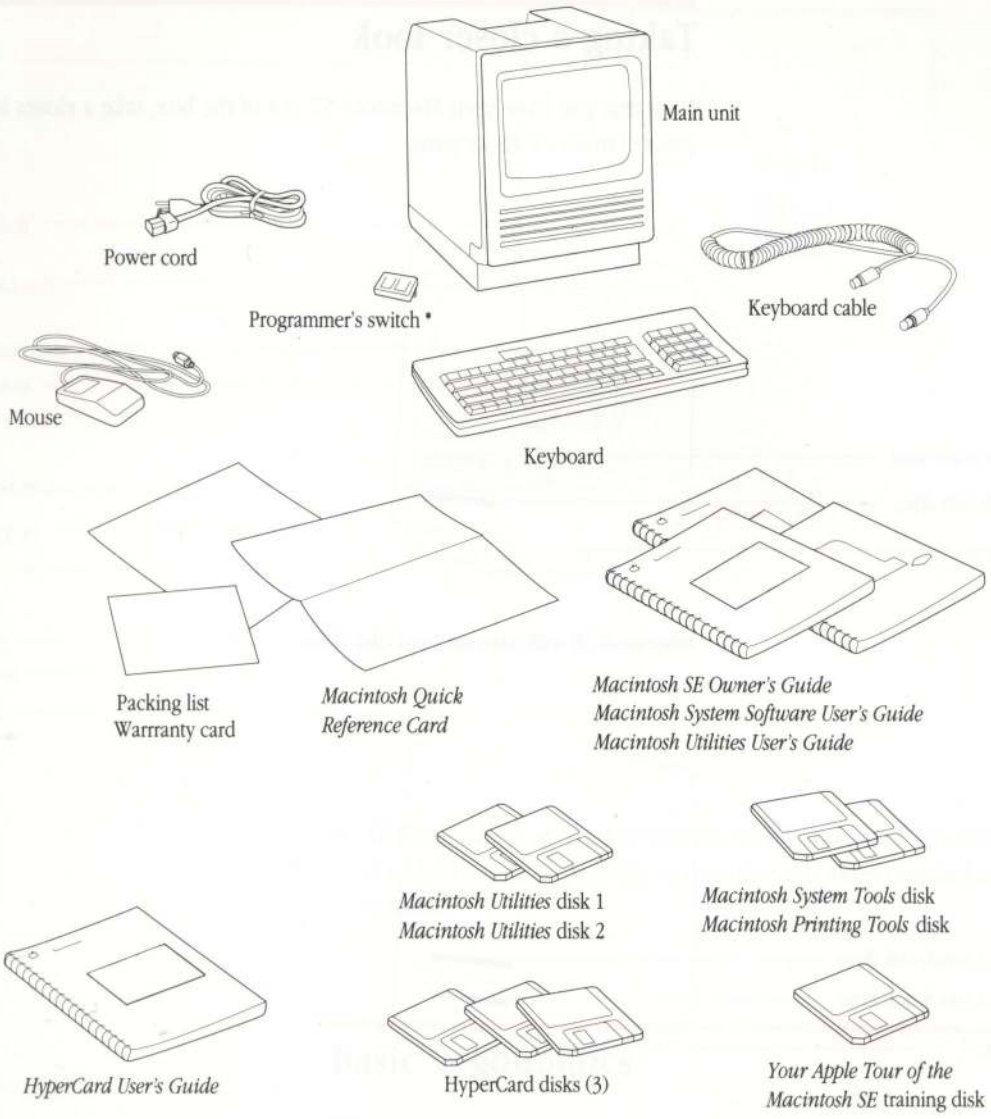
- *Different keyboard?* Apple offers two keyboards for the Macintosh SE. Yours may look different from the one shown here.

Check your packing lists to make sure you have everything. If something is missing, contact your authorized Apple dealer or representative.



Be sure to fill out the product registration card and mail it in. The registration card asks for the computer's serial number; you'll find the number on the left side of the back of the main unit, just below the bar code.

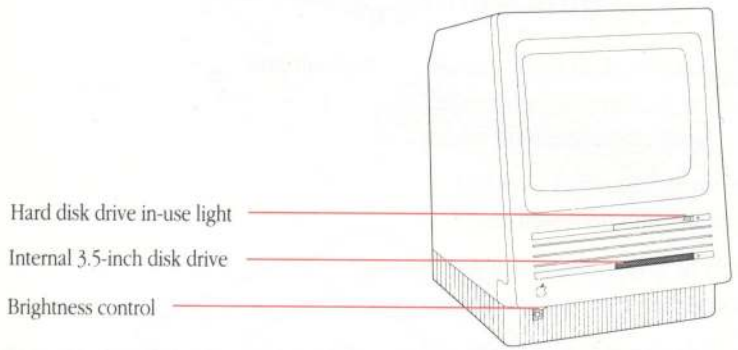
- *Save the packing materials:* Keep the boxes and all the packing materials; repack your computer system to protect it from rough handling and jarring if you have to move it over long distances. It's especially important to repack your computer if it has an internal hard disk drive.



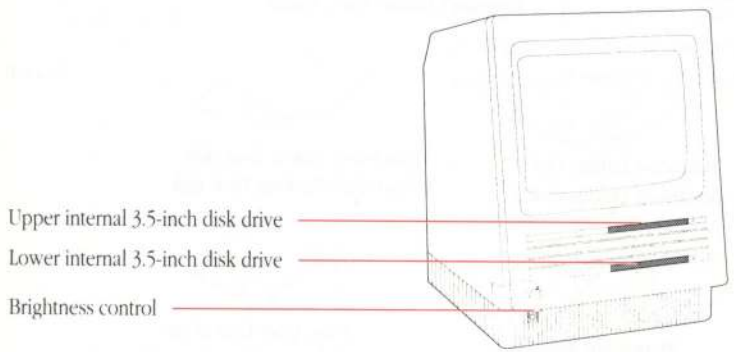
* Put this aside for now. You won't install the switch unless you're developing application programs for the Macintosh SE.

Taking a closer look

Now that you have your Macintosh SE out of the box, take a closer look so you're familiar with its parts.

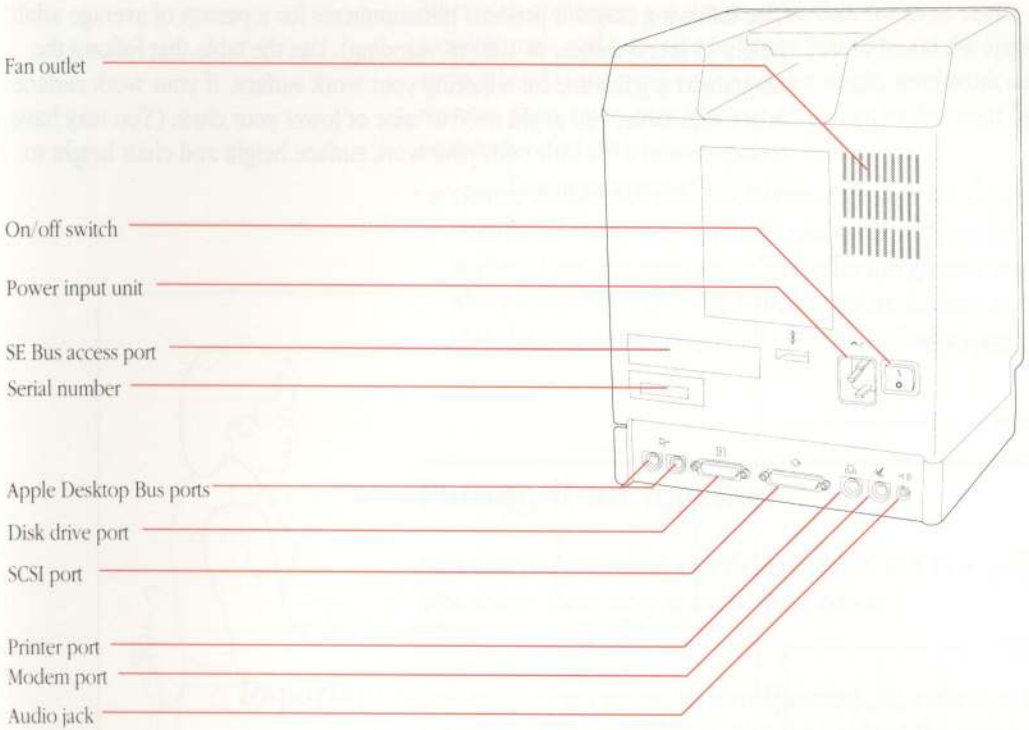


Macintosh SE with internal hard disk drive



Macintosh SE with second internal 3.5-inch disk drive

Everything you connect to the Macintosh SE attaches to connectors, or **ports,** on the back panel of the computer. You can usually tell which port to use by looking at the **icons** (small pictures) above each one. You probably won't need them all right away; you'll learn more about some of them in the next few sections. (All the ports on the back panel are discussed in more detail in Chapter 4, "Macintosh SE Ports and Buses.")



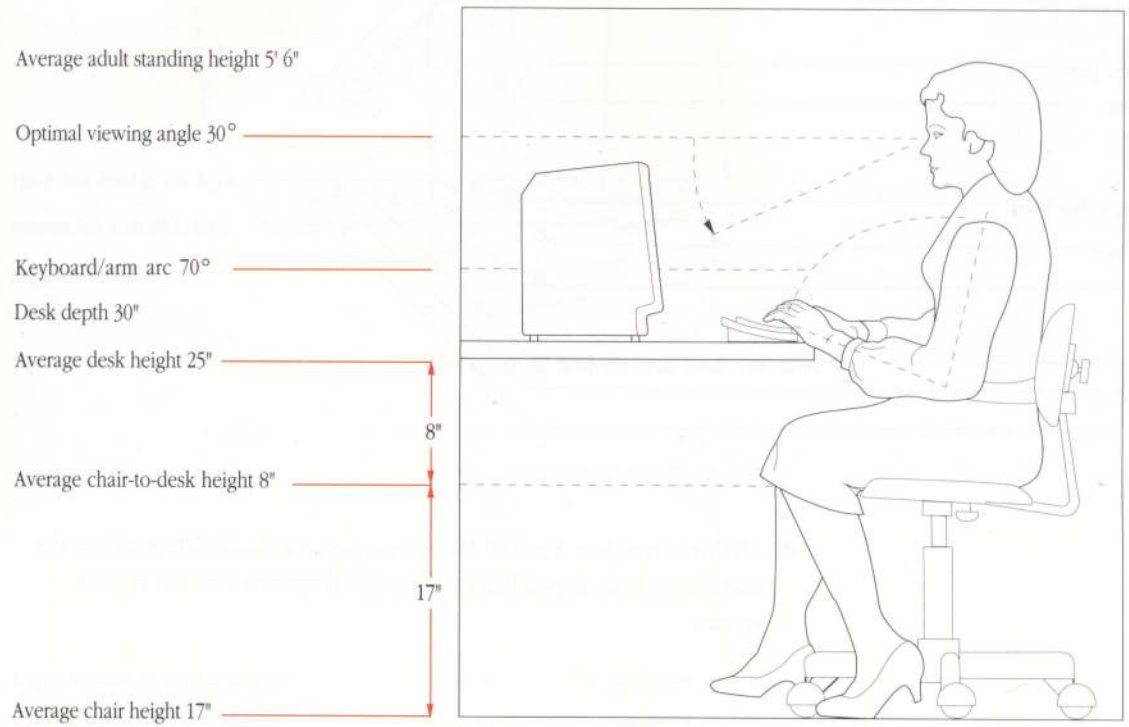
- *SE Bus access port:* Your SE Bus access port may look different from the one shown here, depending on the internal options installed in your system.

Basic ergonomics

Before you set up your computer, it's a good idea to prepare your work area. Thinking ahead and paying attention to some basic **ergonomics** will help you avoid fatigue, muscle aches, and eye strain.

Of greatest importance are your work surface height and monitor viewing angle. Your hands should rest comfortably at the keyboard so that your lower arms form a 70° to 90° angle with your torso. The monitor screen should be within a 60° viewing angle; a 30° viewing angle is optimal.

The following diagram presents measurements for a person of average adult height (5 feet 6 inches, or 168 cm, standing). Use the table that follows the diagram as a guideline for adjusting your work surface. If your work surface is not adjustable, you might need to raise or lower your chair. (You may have to experiment a bit with both your work surface height and chair height to find the best arrangement.)



If you are		Your work surface should be	
4 feet 11 inches	150 cm	23 inches high	58 cm
5 feet 4 inches	163 cm	24 inches high	61 cm
5 feet 6 inches	168 cm	25 inches high	64 cm
5 feet 9 inches	175 cm	26 inches high	66 cm
6 feet 2 inches	188 cm	28 inches high	71 cm

Macintosh computers are designed so that, for most users, the monitor viewing angle will be within 60° once you've found the appropriate work surface height (assuming you're using a single, level work surface.) To avoid monitor glare, try to position your computer so that your light source is neither directly behind nor directly in front of you.

- *Getting it right:* Some furniture manufacturers offer specially designed "computer" desks with separate adjustable surfaces for both the keyboard and the main unit; these offer the greatest range of adjustment. Also available are computer stands, antiglare screens, and other equipment to make your work environment fit your individual needs.

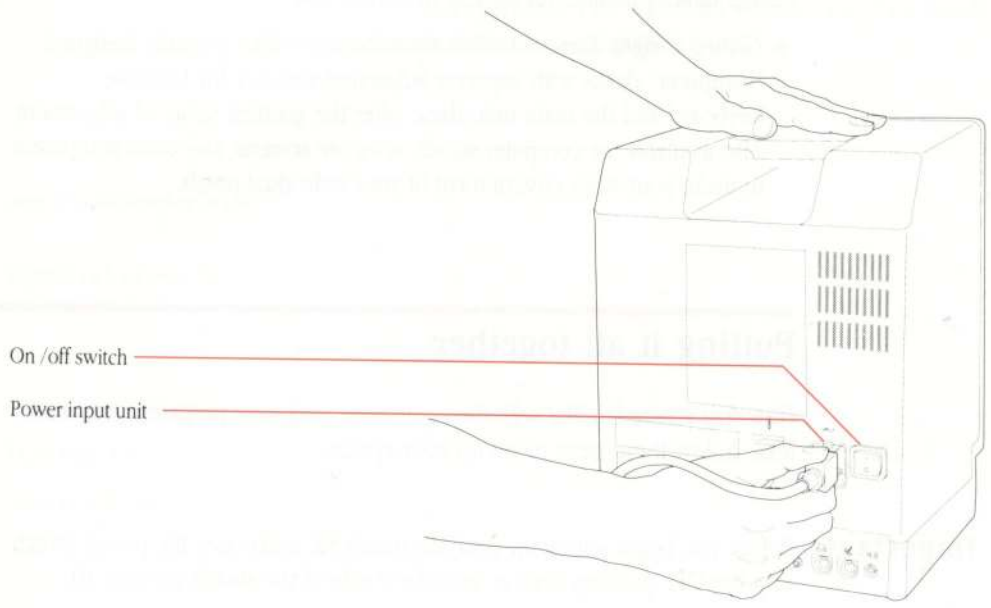
Putting it all together

Now that you're familiar with the equipment, and have prepared your work area, follow these steps to set up your system.

△ Important Before you begin setting up your Macintosh SE, make sure the power switch is in the OFF position (that is, with the 0 side of the switch pressed in). △

The power cord

- **Plug the socket end of the power cord into the power input unit on the back of the Macintosh SE. It's next to the on/off switch.**



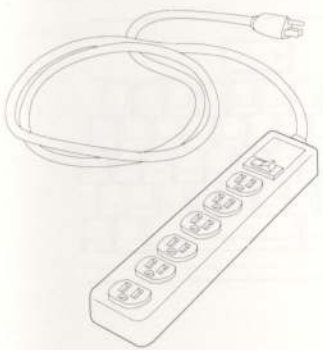
- **Plug the other end of the power cord into a three-hole, grounded outlet.**

△ **Important** Don't turn on the computer just yet. Wait until you've connected all the parts of your system and you've read the "Important Safety Instructions" section later in this chapter.△

▲ Warning This equipment is intended to be electrically grounded. Your Macintosh SE is equipped with a three-wire grounding plug—a plug that has a third (grounding) pin. This plug will fit only a grounding-type AC outlet. This is a safety feature. If you are unable to insert the plug into the outlet, contact a licensed electrician to replace the outlet with a properly grounded outlet. Do not defeat the purpose of the grounding plug!

As you continue setting up your Macintosh SE system, leave the power cord plugged in, but be sure the power switch is turned *off*. When properly connected to a grounded outlet, the power cord acts as a ground for your system, protecting its components from static electrical discharge—even when the computer is turned off. ▲

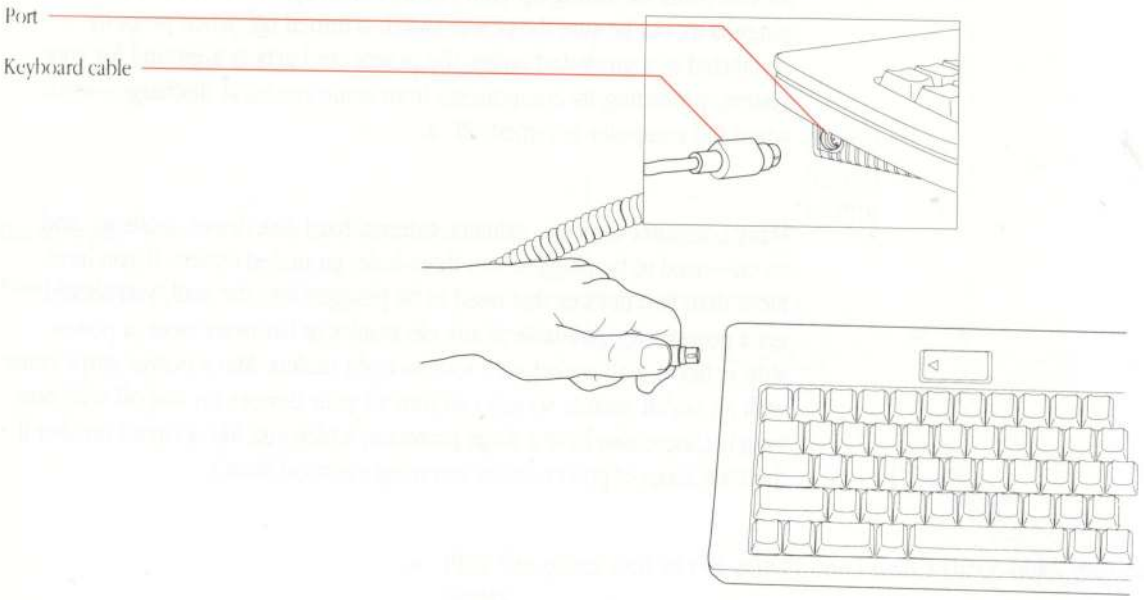
Many computer devices—printers, external hard disk drives, modems, and so on—need to be plugged into three-hole, grounded outlets. If you have more than two devices that need to be plugged into the wall, you should get a power strip. Available at any electronics or hardware store, a power strip is like a wall socket with four to eight outlets. Many power strips come with an on/off switch, so you can turn all your devices on and off with one switch. (Some also have a surge protector, which acts like a circuit breaker if there's a surge of power on the incoming electrical lines.)



The keyboard and the mouse

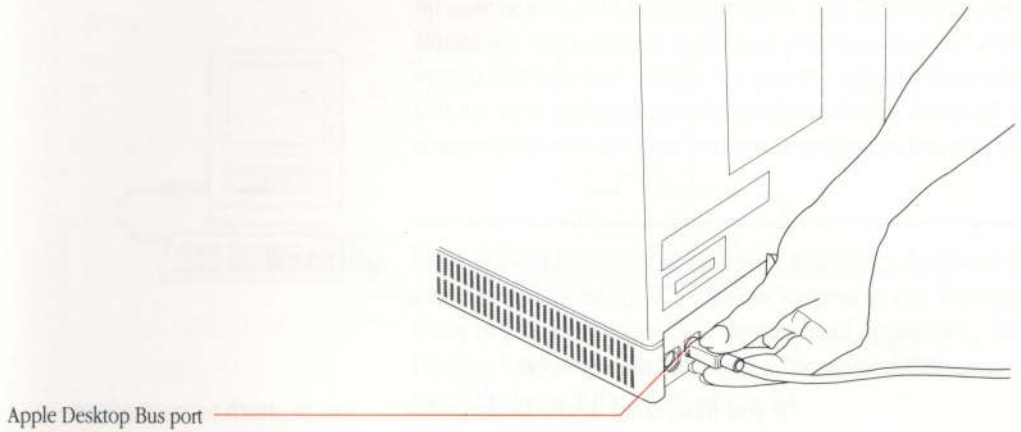
There are several ways to connect the keyboard and mouse to the computer. The following steps show just one way. When you've completed this procedure, you'll find information on some alternatives.

- **With the keyboard facing you, plug one end of the keyboard cable into the port on the left side of the keyboard.**



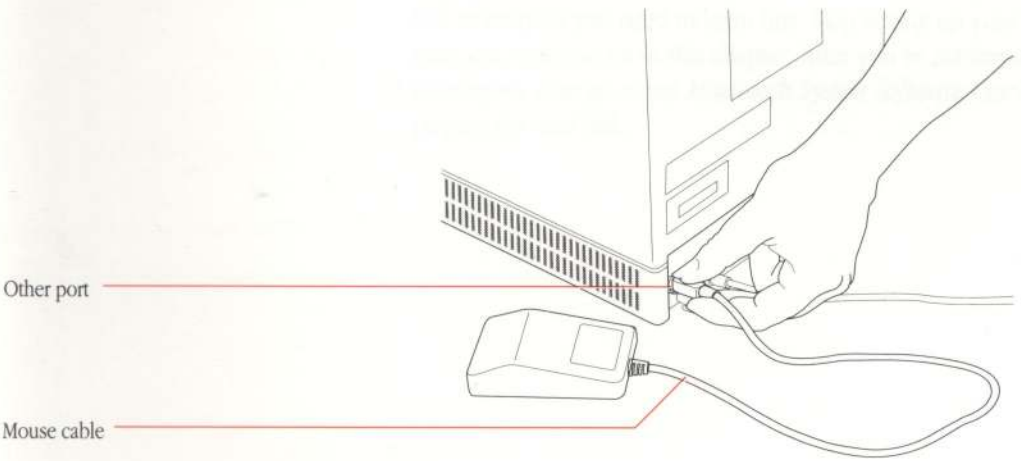
❖ *Different keyboard?* Even if you're using a different keyboard, you connect it to the computer in the same way.

- **Plug the other end of the keyboard cable into either one of the two small ports on the back of the Macintosh SE.**

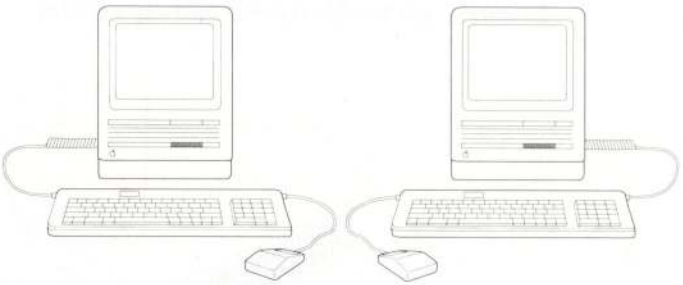


The official name for this set of ports is the **Apple Desktop Bus™.** You'll see how to connect other Apple Desktop Bus devices in a minute.

- **Plug the mouse cable into the other port on the back of the Macintosh SE.**



You might prefer to **daisy-chain** the mouse to the keyboard, using the second port on the keyboard rather than the port on the back panel of the computer. It's up to you. Here are some possibilities:



If you have other Apple Desktop Bus devices to attach to your system—a graphics tablet, a joystick, or another keyboard, for example—you can either daisy-chain them to the keyboard or use one of the Apple Desktop Bus ports on the computer's back panel.

△ **Important** If you need to rearrange the devices on the Apple Desktop Bus while using your system, turn off the computer before connecting or disconnecting any devices. △

Other devices

You may have purchased other computer equipment—a printer, an external disk drive, or a modem, for instance. You'll find instructions for connecting those devices in the manuals that came with them. Whether you set them up now or wait until later depends on how familiar you are with using a Macintosh: some devices require an understanding of how to use Macintosh system software and utilities for you to complete their setup procedures. If you are new to the Macintosh, you're probably better off putting the other components aside for now and continuing on in this chapter.

▲ Warning Some devices may be SCSI devices. (*SCSI* stands for *Small Computer System Interface.*) Connecting SCSI devices incorrectly can damage your system. If any of your devices are SCSI devices, read Appendix C, "Connecting SCSI Devices," *before* connecting them. (The manual that came with the device should tell you if it's a SCSI device.) ▲

Internal hard disk

If your system includes an internal hard disk drive, you might need to prepare it for use; the procedure is explained in the *Macintosh System Software User's Guide*. For the veteran Macintosh user, it's easy—read the next section, "Important Safety Instructions," and then go to the system software guide to prepare the hard disk. But if you're a newcomer, the procedure requires a few techniques you need to learn first. Skip setting up your hard disk for now and continue on in this chapter. After you've mastered some Macintosh techniques, then go to the *Macintosh System Software User's Guide* to prepare the hard disk.

Important safety instructions

Now that your system is all set up (or as much as it needs to be for now), you're almost ready to start up your Macintosh SE—but first read these important safety instructions. For your own safety and that of your equipment, always take the following precautions.

Disconnect the power plug (by pulling on the plug, not the cord) under these circumstances:

- if the power cord or plug becomes frayed or otherwise damaged
- if anything is spilled into the equipment
- if your equipment is exposed to rain or any other excess moisture
- if your equipment is dropped or the case has been damaged
- if you suspect that your computer needs servicing or repair
- whenever you clean the case

Be sure you always

- Keep all air vents clear. Leave at least 4 to 6 inches of clearance between the vents on both sides and back of the main unit and any object that may restrict air flow.
- Keep your equipment away from any source of liquid. If you drink a beverage while you're at your computer, take care not to spill.
- Protect your equipment from damp or wet weather.
- Keep these instructions handy for reference.
- Follow all instructions and warnings dealing with your system.

▲ Warning Electrical equipment may be hazardous if misused. Operation of this product or similar products must always be supervised by an adult. Do not permit children to handle cables. ▲

Starting up the computer

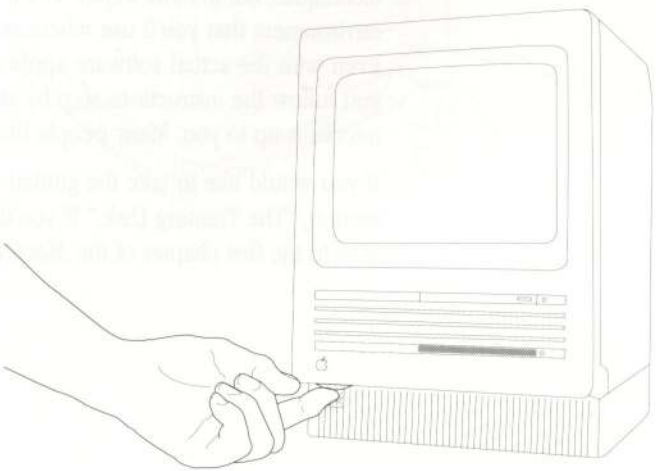
Follow these steps to start up your Macintosh SE:

- **Switch the power switch to the ON position.**

A beep lets you know the computer has started. If this is the first time the power has been turned on, a yellow sheet of plastic will pop out of the disk drive (or drives, if your system includes the second internal 3.5-inch drive). Remove the plastic piece from the disk drive, but don't discard it. If you ever need to transport your Macintosh SE, inserting the sheet in the disk drive will prevent damage to the drive during shipping.

An **icon** (a small picture) representing a Macintosh disk appears on the screen. The blinking question mark shows that the Macintosh SE is ready for you to insert a disk.

- **You may need to adjust the brightness control to the level you prefer.**



△ **Important** If you see something other than the question mark icon on your screen, and your system includes an internal hard disk drive, someone may already have prepared the hard disk for you. For now, just turn off the Macintosh SE and continue on in this chapter. △

Training disk or tutorial?

Before you begin learning how to operate your Macintosh SE, you have a choice to make. The material presented in the training disk, *Your Apple Tour of the Macintosh SE,* is also taught in a tutorial in the *Macintosh System Software User's Guide.* Both are designed to give you first-hand experience using the computer, but in different ways.

The training disk is an interactive guide to the Macintosh SE. That means it teaches you Macintosh concepts and techniques, prompts you step by step, and corrects you when you've made a mistake. It provides you with an entertaining, controlled learning environment.

The tutorial uses real software applications to teach you the same techniques, but in more depth. You'll be learning in the same working environment that you'll use whenever you work with your Macintosh SE. Even with the actual software applications, you won't make any mistakes if you follow the instructions step by step. Whether you use the disk or the tutorial is up to you. Many people find it helpful to use both.

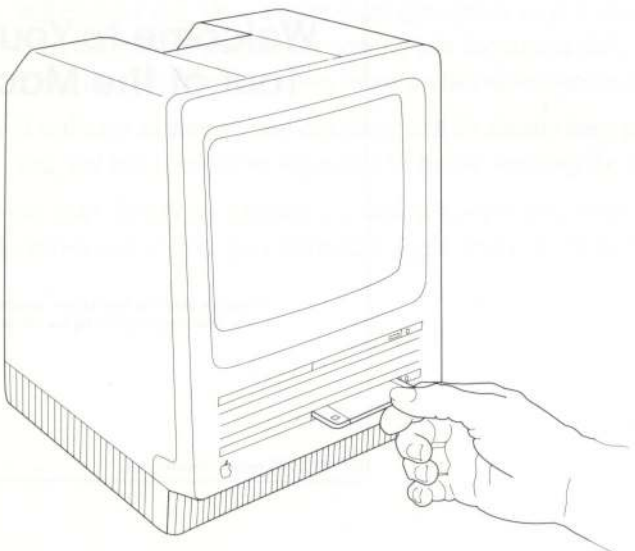
If you would like to take the guided tour, follow the steps in the next section, "The Training Disk." If you'd rather stay with the printed page, skip now to the first chapter of the *Macintosh System Software User's Guide.*

The training disk

Follow these steps to start up *Your Apple Tour of the Macintosh SE*:

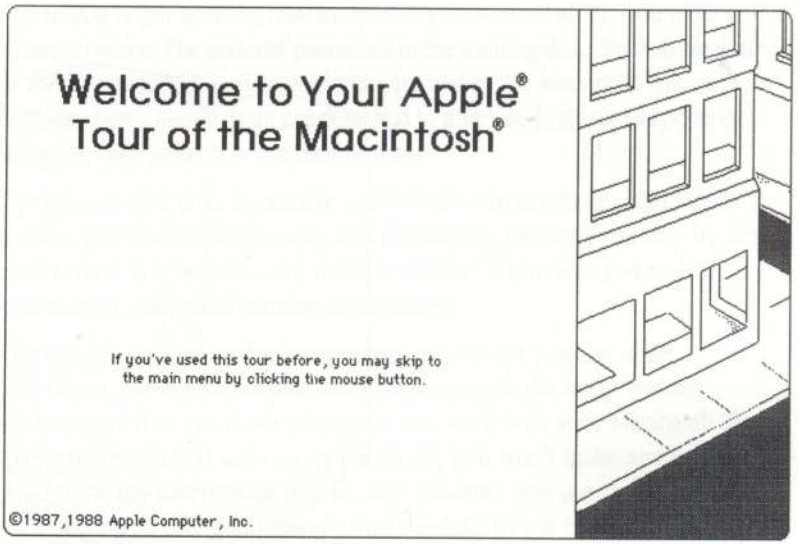
- **Insert the disk labeled *Your Apple Tour of the Macintosh SE* into the disk drive, metal end first, label side up.**

If your system includes a second internal 3.5-inch drive, insert the disk in the *lower* of the two drives.



If you switched off the computer earlier after seeing something other than the question mark icon on your screen, insert the training disk now and switch the computer back on again. This should get you started correctly.

When the disk is most of the way into the disk drive, the Macintosh SE automatically pulls it in and into place. The soft hum you hear is the Macintosh SE starting up the training disk. After a few moments, you should see a display welcoming you to the guided tour.


Welcome to Your Apple®
Tour of the Macintosh®
If you've used this tour before, you may skip to the main menu by clicking the mouse button.
©1987,1988 Apple Computer, Inc.

- **Follow the instructions that appear on the screen.**

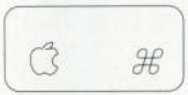
Use the training disk as long as you like. Anything you need to know to use the disk will be explained right on the screen.

Problems starting up?

If you don't see the opening display, go through the following list to see if you can identify the problem:

- Is the computer plugged into a power source?
- If your computer is plugged into a power strip, is the power strip turned on?
- Is the computer power switch turned on?
- Is the brightness control adjusted correctly?
- Are you using the correct disk? To check, hold down the Command and Shift keys while you press the 1 key on the main keyboard. This will eject the disk. (You'll learn more appropriate ways to eject disks later, but use this shortcut for now.) If it is the correct disk, reinsert it into the disk drive (the lower drive, on two-drive systems).
- If you have an internal hard disk drive, and it's already been prepared for you, did you turn off the Macintosh SE before inserting the disk?

If you can't identify the problem yourself, get help from a more experienced Macintosh user or from your authorized Apple dealer or representative.



Command key

Stopping

When you're ready to stop using the training disk:

- **Click the "Quit the Tour" button in the main menu.**

  This will eject the training disk.

- **To stop using the computer for now, just switch it off.**

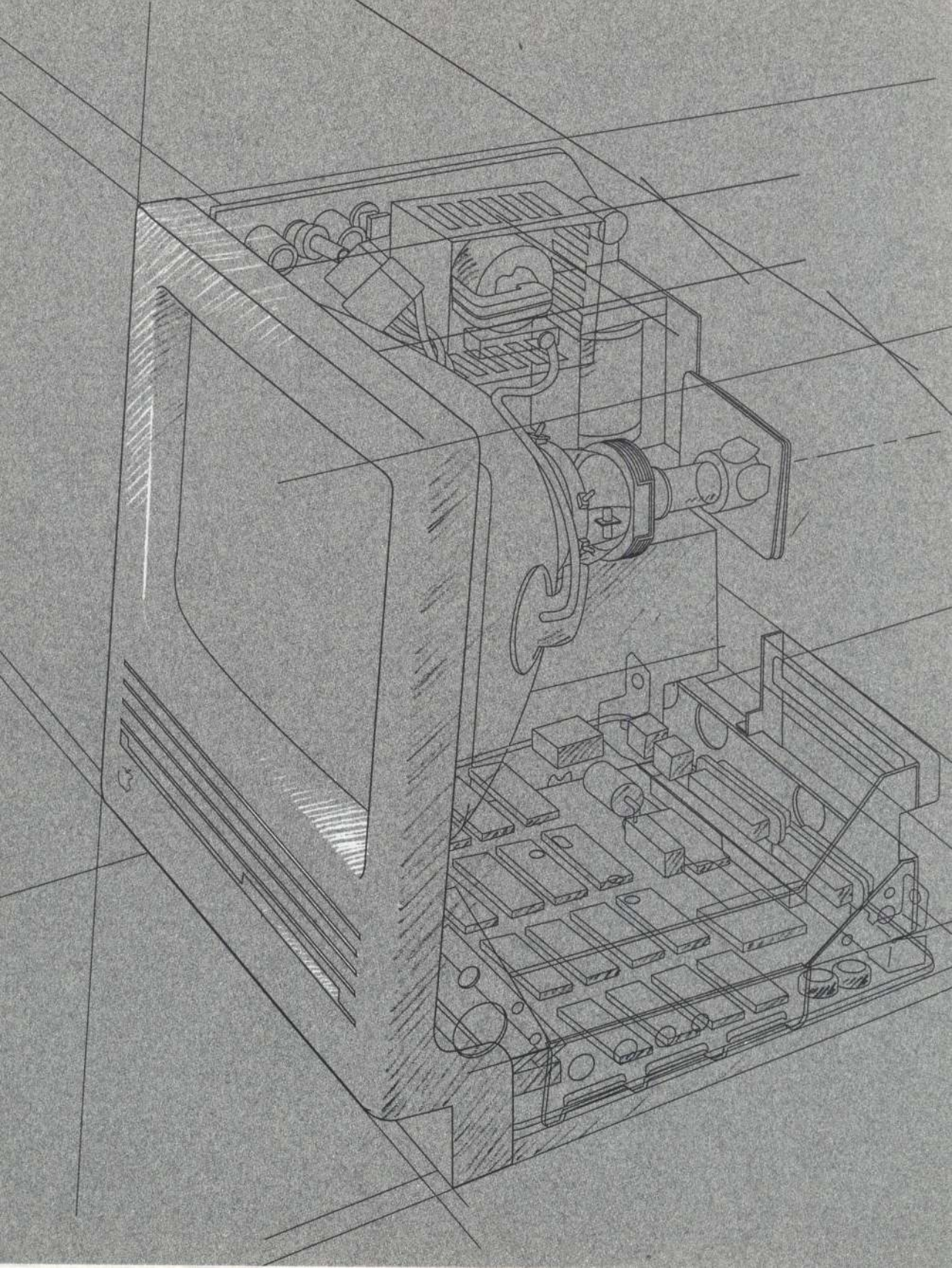
- **To continue working with the Macintosh SE, you can do one of the following:**

  - Go through the tutorial in the *Macintosh System Software User's Guide* for some additional practice.
  - Insert the *Macintosh System Tools* disk and experiment with the Finder.
  - Start any of your applications (following the instructions in the manual that came with the application).

△ Important You may have to use the Installer on the *Macintosh System Tools* disk to update the system software on your application disks before they'll work on the Macintosh SE. You'll find instructions for using the Installer in the *Macintosh System Software User's Guide.*

If you're uncertain whether you need to update the disk, go ahead and try the disk first. If you get unexpected results—if your keyboard doesn't work correctly, or if the application behaves strangely—these are indications that you probably need to update the system software. △

If your system includes an internal hard disk drive, go to the *Macintosh System Software User's Guide* to get your hard disk set up and running.



CHAPTER 2

Inside the Macintosh SE

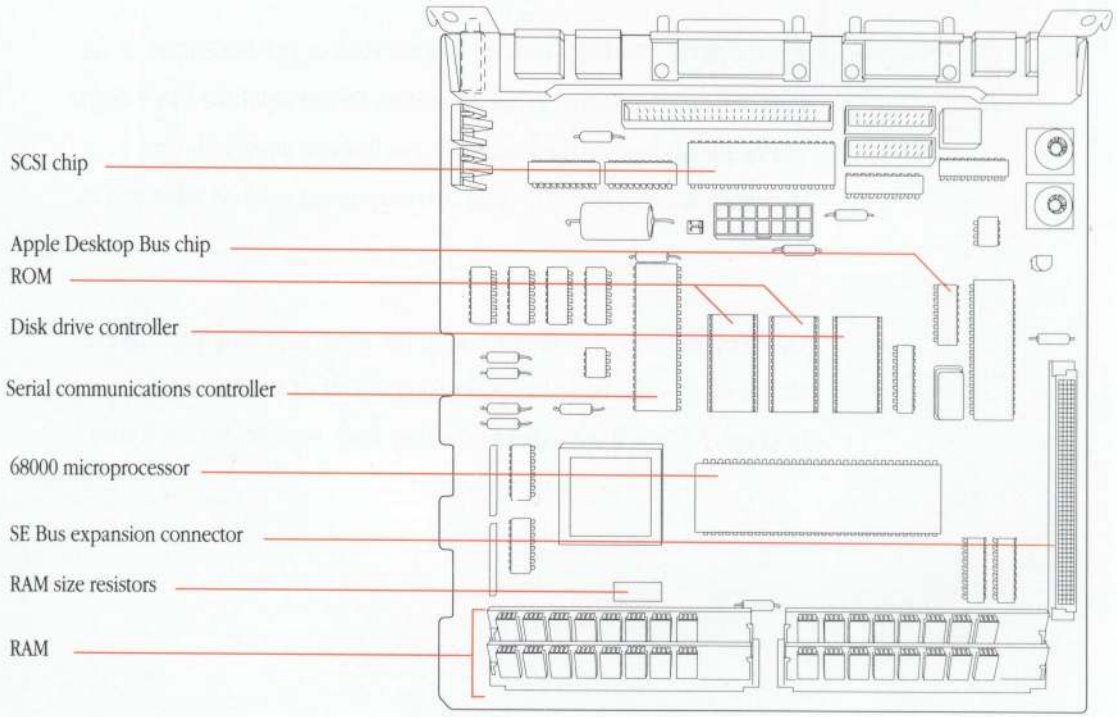
IF YOU USED THE TRAINING DISK, *YOUR APPLE TOUR OF THE MACINTOSH SE,* OR went through the tutorial in the *Macintosh System Software User's Guide,* you've already learned the basic skills you'll use to work with your Macintosh SE computer. The next two chapters expand on what you've learned.

This chapter briefly introduces you to the more important parts of the Macintosh SE—the basic hardware components of your computer system. In Chapter 3, you'll read about how they work together with software.

You don't need to know the material in this chapter or in Chapter 3 to use your Macintosh SE. But a basic familiarity with how a Macintosh works will help you understand advanced concepts that you may encounter in using system software and applications. It may also come in handy when considering hardware options and peripheral devices for your computer.

Here's a brief summary of what you'll read about in this chapter:

- the microprocessor
- RAM and ROM
- the display
- disk drives and disks
- the mouse and the keyboard



Macintosh SE main circuit board

The microprocessor

The **microprocessor** is an integrated circuit, or chip, on the computer's main circuit board that processes the instructions supplied to it by software. In a sense, the microprocessor is the computer's "brain": it controls the computer by directing the flow of electrical impulses, and thereby coordinates the efforts of the other parts of the machine. When the microprocessor receives an instruction, it interprets the instruction and tells the other parts of the computer—the disk drives, the video display, and so on—what they should do.

The instructions the microprocessor receives are in the microprocessor's own vocabulary, known as the microprocessor's **instruction set.** Each microprocessor on the market understands its own set of instructions. The Macintosh SE's microprocessor, the **Motorola 68000,** uses an instruction set particular to it. Software programs are normally designed to run on specific microprocessors. That's one important factor in whether software is **compatible** with the computer system you want to run the software on.

Your Macintosh SE can use other microprocessors than the Motorola 68000. The system contains an internal expansion connector that lets you install an accelerator card or a coprocessor card.

As its name would suggest, an **accelerator card** is a circuit board that increases the computer's processing speed. The more common accelerator cards for the Macintosh SE contain the **Motorola 68020,** the microprocessor that runs the Apple Macintosh II. Programs that are written for use on the 68000 are almost always compatible with the 68020, because the 68020's instruction set includes all the instructions for the 68000—it just processes those instructions much faster. Other accelerator cards add to the increased speed of the 68020 by also including the **Motorola 68881**—a **coprocessor** that performs complex mathematical computations very quickly.

A **coprocessor** is a chip designed to assist the microprocessor, usually in performing very specialized tasks.

The Motorola 68881 coprocessor is usually included right on the accelerator card, but other coprocessors come on their own cards and are designed to run software that isn't ordinarily compatible with the Macintosh's 68000. This is possible because control of the computer is handed over to the coprocessing chip on the card—in effect, turning the Macintosh into another type of computer system.

Bits and bytes

Information is actually processed and stored in computers as electrical charges. A computer contains thousands of minute electrical circuits connected by switches that can be in only one of two states: opened or closed. An open switch does not complete a circuit, so no electrical charge can pass. A closed switch completes a circuit, allowing the charge to flow through it. An open switch is therefore off; a closed switch is on.

A **binary** numbering system is used to represent these two conditions. 0 means off; 1 means on. Each 0 or 1 represents one binary digit, or **bit.** Each letter, number, and

RAM

Your Macintosh SE uses two types of **memory,** both contained in more chips connected to the computer's main circuit board. **RAM** is one type; its name is an acronym that stands for **random-access memory.** RAM is the computer's working area, the primary location where the microprocessor stores the information it needs. It's called *random-access* because of the microprocessor's ability to get at information in memory randomly by knowing its location, or **address,** rather than by having to hunt through memory sequentially from beginning to end, as you would with a cassette recorder when you're looking for a particular song.

Because information in RAM is stored electronically, accessing data stored in RAM is much faster than getting that data from a mechanical storage device such as a disk drive. But because it is stored electronically, all information in RAM is temporary: when you switch off the computer, everything in RAM disappears. (That's why you must save your work on a more permanent storage medium, such as a disk.)

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punctuation mark on the keyboard has its own distinct arrangement of eight bits, called a **byte.** Most computers use a standardized system for the binary representation of characters called **ASCII,** an acronym that stands for American Standard Code for Information Interchange, and is pronounced "ASK-ee."

Counting individual bytes would result in astronomical numbers; it's more often convenient to use larger units, such as **kilobytes** and **megabytes.** A kilobyte is 1024 bytes (2 to the tenth power) and represented with a **KB,** or more informally, **K.** A megabyte is 1024 kilobytes, and represented **MB.**

You'll often hear computer memory, disk storage space, and application and document sizes described in K's or MB's. For instance, the text of this manual occupies about 250K, or 256,000 bytes; the minimum amount of RAM in the Macintosh SE is 1 MB, or 1024K.

When you start up an application, the microprocessor finds the application at its permanent location on a disk, and transfers a temporary copy of the application (or segments of it) into RAM. And when you create a document with the application, the document is stored there, too. The amount of space in RAM is therefore an important factor in how complex the application can be and how large a document you can create with it. The Macintosh SE comes with a minimum of 1 megabyte (1 MB) of RAM. If you need more space, RAM in the Macintosh SE can be expanded by installing additional RAM chips, up to a maximum system capacity of 4 megabytes.

Extra RAM means you can work with more sophisticated applications, or work with more applications open at the same time. And extra RAM can increase the computer's performance, too. With 1 megabyte of RAM, the microprocessor may occasionally need to go to the disk drive to load in segments of an application program, if the application is too large to fit entirely into RAM. Additional RAM cuts down on disk access time by allowing more of the application's **code** to reside in RAM rather than on the disk.

Code is another term for computer instructions.

RAM chips are contained on small circuit boards that attach directly to the computer's main circuit board. Because installing extra RAM chips requires opening the main unit, your dealer must install them for you.

ROM

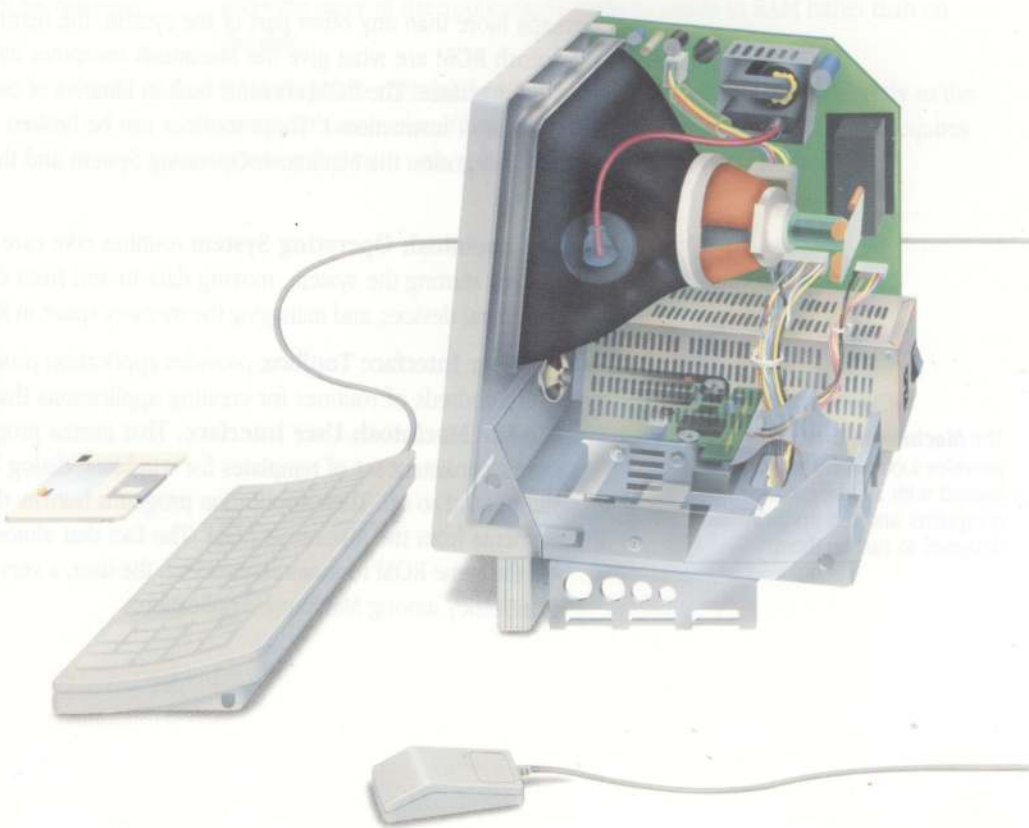
ROM is another type of computer memory; its name is an acronym that stands for **read-only memory.** It's called *read-only* because the microprocessor can read and use the information in the ROM chip, but it can't store anything there. The contents of ROM are permanent and cannot be erased or changed.

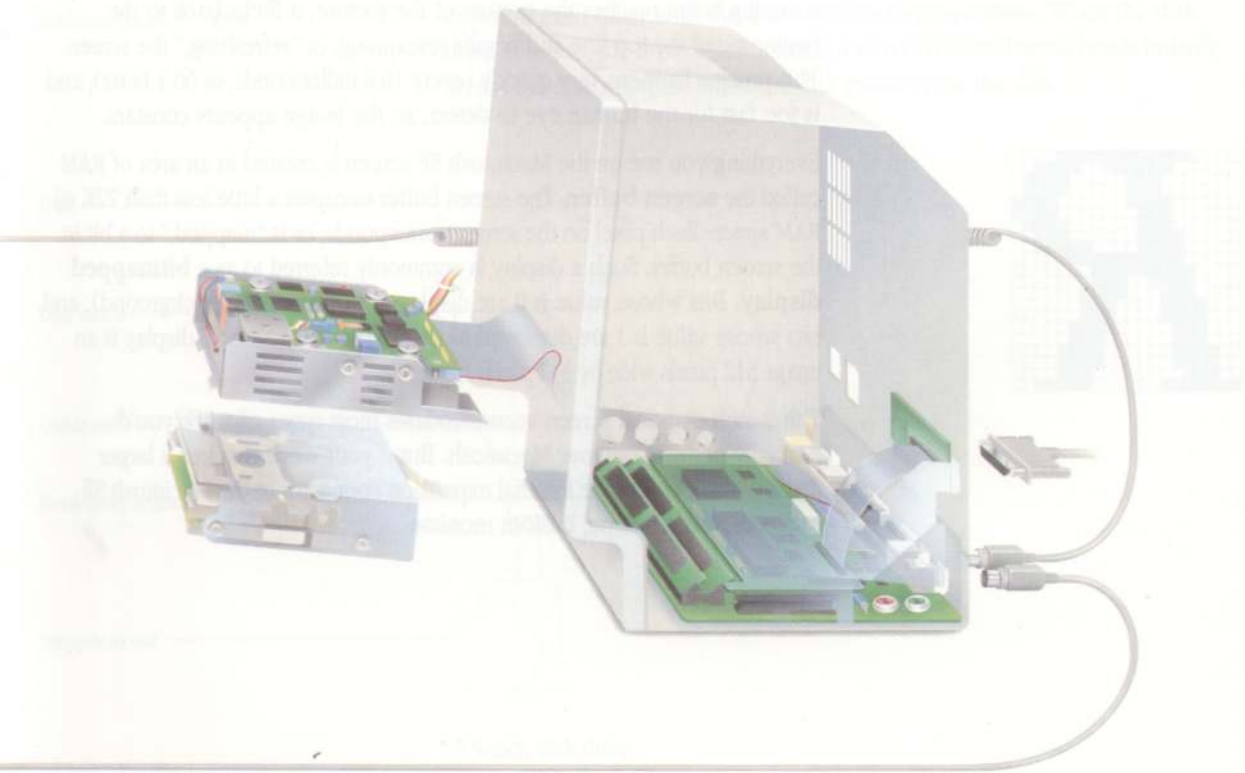
Whereas RAM chips store both applications and data that change every time you use your computer, ROM chips contain information that never changes. And unlike the contents of RAM, the information in ROM stays intact when you turn off the computer. The ROM holds important instructions that the microprocessor needs to make the computer work. These instructions are just like other forms of software instructions, but because they are permanent and unchangeable, they are often referred to as **firmware.**

Perhaps more than any other part of the system, the features of the Macintosh ROM are what give the Macintosh computer its distinctive "user-friendly" interface. The ROM contains built-in libraries of over 700 **routines** (sequences of instructions). These routines can be broken down into two general categories: the Macintosh Operating System and the User Interface Toolbox.

- The **Macintosh Operating System** routines take care of basic tasks such as starting the system, moving data to and from disks and peripheral devices, and managing the memory space in RAM.
- The **User Interface Toolbox** provides application program developers with hundreds of routines for creating applications that conform to the standard **Macintosh User Interface.** That means programmers can start with a consistent set of templates for windows, dialog boxes, icons, menus, and so on. Their application programs borrow these common elements from the Macintosh ROM. The fact that almost all applications use the same ROM routines assures you, the user, a very high level of consistency among Macintosh applications.

The **Macintosh User Interface** provides a consistent way for you to interact with all Macintosh computers and the applications designed to run on them.

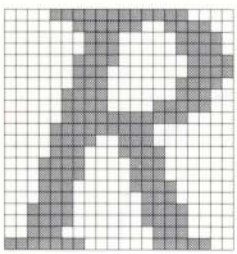




The display

The Macintosh SE uses a cathode-ray tube (sometimes abbreviated *CRT*) for its display, similar to those found in common televisions. The Macintosh SE video display is created by a moving electron beam inside the picture tube that scans across the screen. As it scans, it turns on and off to create tiny black and white dots. These dots are called **pixels** (short for *picture elements*).

To present a screen image, the electron beam starts at the top-left corner of the screen. The beam scans horizontally across the screen from left to right, turning on and off to create individual pixels, forming a line of graphics. Each time the scanning beam reaches the right edge of the picture, it flicks invisibly back to the left edge and down a pixel to the beginning of the next line, much as you move your eyes when you read a line of print. When the scanning beam reaches the bottom of the picture, it flicks back to the beginning of the top line and begins rescanning, or "refreshing," the screen. This process happens very quickly (every 16.6 milliseconds, or 60.1 hertz), and is too fast for the human eye to detect, so the image appears constant.

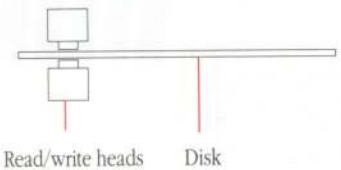


Everything you see on the Macintosh SE screen is created in an area of RAM called the **screen buffer.** The screen buffer occupies a little less than 22K of RAM space. Each pixel on the screen corresponds, or is "mapped," to a bit in the screen buffer. Such a display is commonly referred to as a **bitmapped display.** Bits whose value is 0 are displayed as white dots (background), and bits whose value is 1 are displayed as black. The Macintosh SE display is an image 512 pixels wide by 342 pixels high.

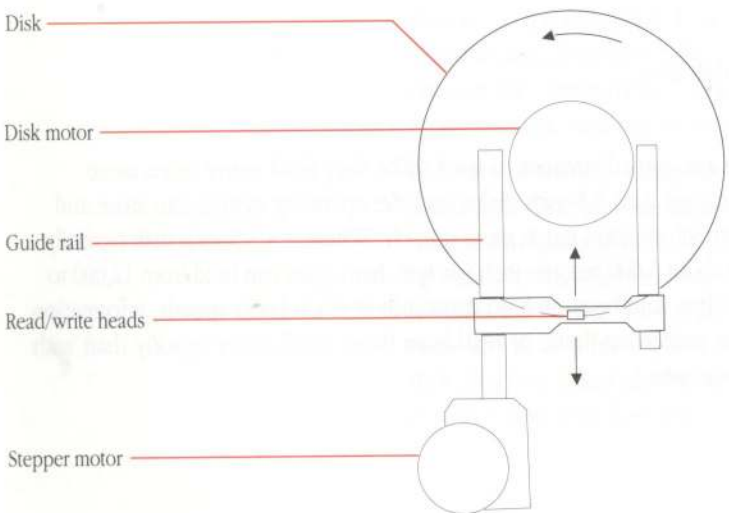
The 9-inch diagonal screen accommodates most types of work you'd normally perform on your Macintosh. But if your work requires a larger display, you can use the internal expansion connector in the Macintosh SE to attach a stand-alone, custom monitor.

Disk drives and disks

A computer would be of little use if you couldn't load information into RAM or if you couldn't store your documents after you'd finished working with them. Remember that the contents of RAM disappear when you shut off the computer, so your applications and data must be stored on a more permanent medium. That's what **disk drives** and **disks** are for. Disk drives record information on thin, circular disks, coated with a magnetic surface. Macintosh computers use two types of disks—**3.5-inch disks** (sometimes called "floppies") and **hard disks.**

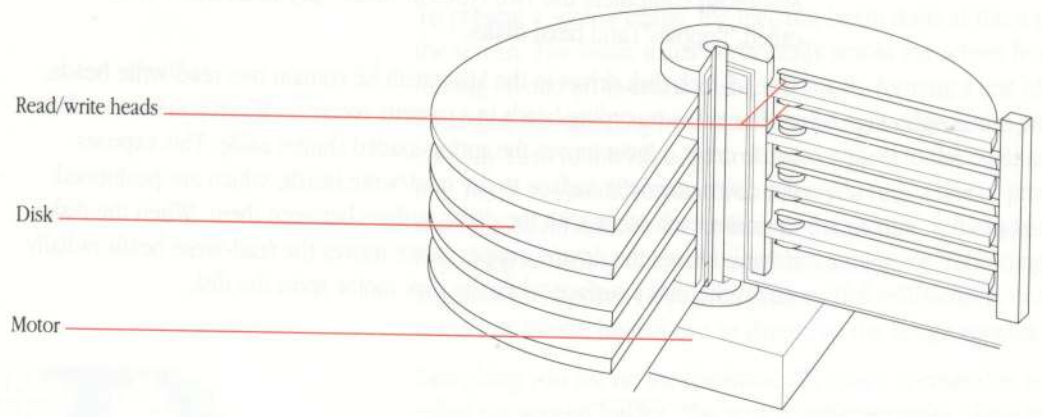


The 3.5-inch disk drives in the Macintosh SE contain two read/write heads, similar to the recording heads in a cassette recorder. When you insert a disk in the drive, a lever moves the spring-loaded shutter aside. This exposes the disk's magnetic surface to the read/write heads, which are positioned opposite each other with the disk's surface between them. When the disk drive is in use, the drive's stepper motor moves the read/write heads radially across the disk's surface while the disk motor spins the disk.



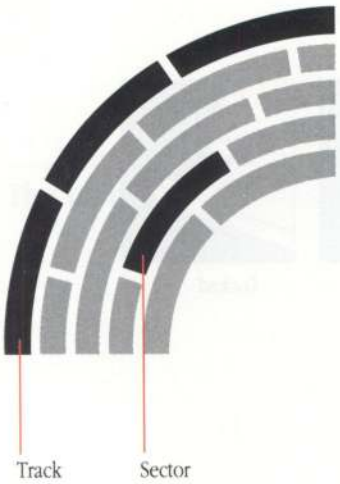
3.5-inch disk drive

Hard disk drives record information in the same manner as 3.5-inch disk drives. But instead of thin, flexible plastic, hard disk drives use rigid metal disks encased permanently inside the drive. Hard disk drives contain one or more disks, depending on the overall storage capacity of the drive, each disk with its own pair of read/write heads. Unlike 3.5-inch disks, which turn inside the drive only when the operating system is storing or retrieving data, the disks inside a hard disk drive spin continuously whenever the power is on.



Hard disk drive

There are two advantages to hard disks: they hold many times more information than 3.5-inch disks, and the operating system can store and retrieve information much more quickly. Whereas a 3.5-inch disk typically holds about 5,000 bits per inch (or *bpi*), hard disks can hold from 12,000 to 15,000 bpi. And because hard disks spin at much faster speeds, information can be written on them, or read from them, much more quickly than with 3.5-inch disks.



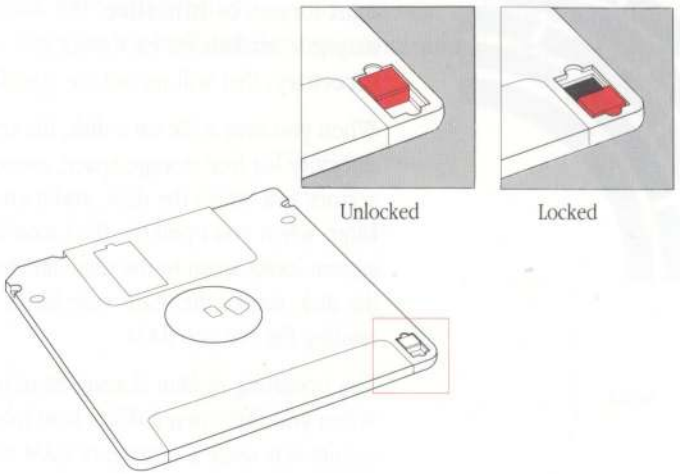
Apart from storage capacity and speed, the two types of disks actually work in much the same way. For the operating system to locate information on disks, the magnetic surface of the disk is divided into concentric circles, or **tracks,** and each track is divided into **sectors.** When you insert a blank disk in a disk drive (or when you use a hard disk for the first time), the disk drive must format, or **initialize,** the disk's surface. This involves setting magnetic markers for each track and sector and creating an index, or **disk directory,** that will record the specific locations of data stored on the disk.

When you save a file on a disk, the operating system looks in the disk directory for free storage space, moves the read/write heads to the free sectors and writes the data, and then records a directory entry for the file. Later, when you open the file's icon from the Finder desktop, the operating system looks again in the disk directory, finds the file's name and location on the disk, moves the read/write heads to the appropriate sectors, and begins reading the file into RAM.

The operating system doesn't store information on the disk right away. When you first open a disk's icon from the Finder desktop, the operating system sets aside a portion of RAM as a **disk buffer,** which acts as a temporary storage area. As a time-saving measure, most applications write changes to the disk buffer in RAM and then only periodically transfer those changes to the disk itself. That's why you shouldn't remove a 3.5-inch disk from the disk drive manually: you must use the Finder to eject the disk because the operating system needs to record the contents of the disk buffer onto the disk before ejecting it.

Disks are permanent storage devices, in the sense that once a file has been saved on a disk, you can shut off the computer and the information is still recorded magnetically on the disk. But disks are reusable. Individual files can be removed (by dragging their icons to the Trash), and the sectors formerly used for storing that file can be used again. Removing a file doesn't actually erase any data; it merely lists those sectors as free for future storage in the disk directory. Reinitializing the disk erases all the data from the disk and creates a new disk directory.

If you want some added assurance that the contents of a disk won't be changed or erased inadvertently, you can **lock** a 3.5-inch disk by sliding the small tab toward the edge of the disk to expose the little hole beneath it.



When a disk is locked, you can't add new information to it or change any information on it. You can open and print the documents it contains, but you won't be able to save, delete, rename, move, duplicate, or change any information on it. (Some applications won't work if they are on a locked disk.) To allow the disk to be altered again, just slide the tab to cover the hole.

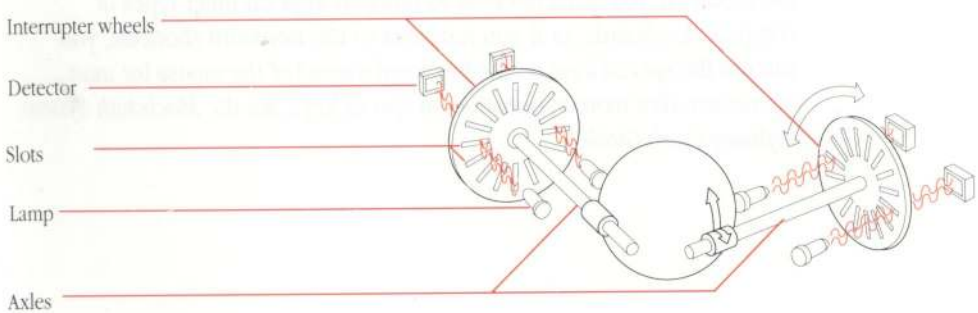
The mouse and the keyboard

The mouse and the keyboard are tools for communicating with your Macintosh SE. They are your computer's primary **input devices.**

The mouse

The Macintosh mouse is a hand-operated device that lets you easily control the location of the pointer on your screen and make selections and choices with the mouse button. Coupled with the graphic elements of the Macintosh User Interface—icons, windows, pull-down menus, and so on—the mouse makes ordinary operation of the system almost effortless: you view your work on the screen and interact with it merely by pointing with the mouse and clicking the mouse button.

The Macintosh mouse contains a rubber-coated steel ball that rests on the surface of your working area. When the mouse is rolled over that surface, the ball turns two rotating axles inside the mouse, each connected to an interrupter wheel. These wheels contain precisely spaced slots through which beams of light are aimed at detectors. The wheels track vertical and horizontal motions. As the axles turn the wheels, the light beams shining through their slots are interrupted; the detectors register the changing optical values, and a small integrated circuit inside the mouse interprets them and signals the operating system to move the pointer on your screen accordingly. (There's also a third axle that helps balance the ball and keep it rolling smoothly.)



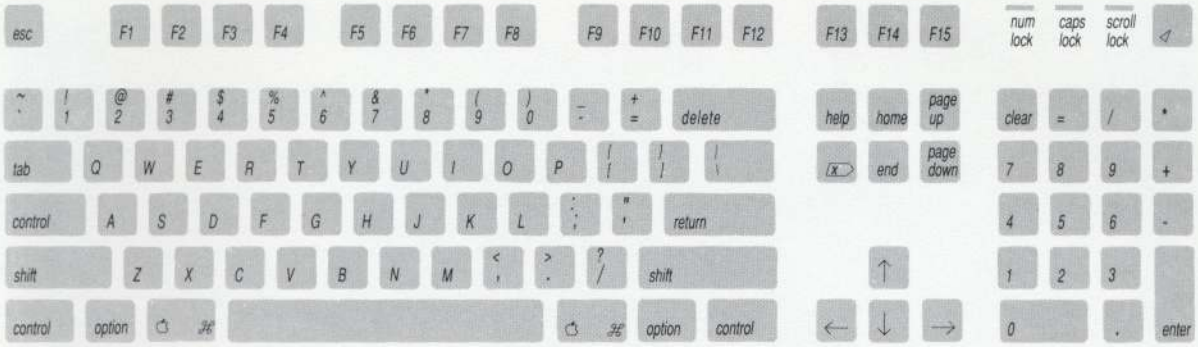
The mouse registers relative movement only; the operating system can tell how far the mouse has moved and in which direction, but not the mouse's absolute location. That's why you can pick up the mouse and move it to another place on your table or desk surface and the pointer will not move. You can adjust the speed with which the pointer on the screen responds to the mouse's movements by using the Control Panel desk accessory in the Apple menu.

The keyboard

The keyboard is another tool for communicating with the computer. Apple offers two choices of keyboards for your Macintosh SE system: the Apple Keyboard and the Apple Extended Keyboard. Both keyboards have a common set of keys; the Apple Extended Keyboard has additional keys that you may be familiar with if you've worked with applications that run on other operating systems such as MS-DOS or UNIX. With appropriate software, these additional keys can be programmed for special purposes and used with Macintosh applications, too.

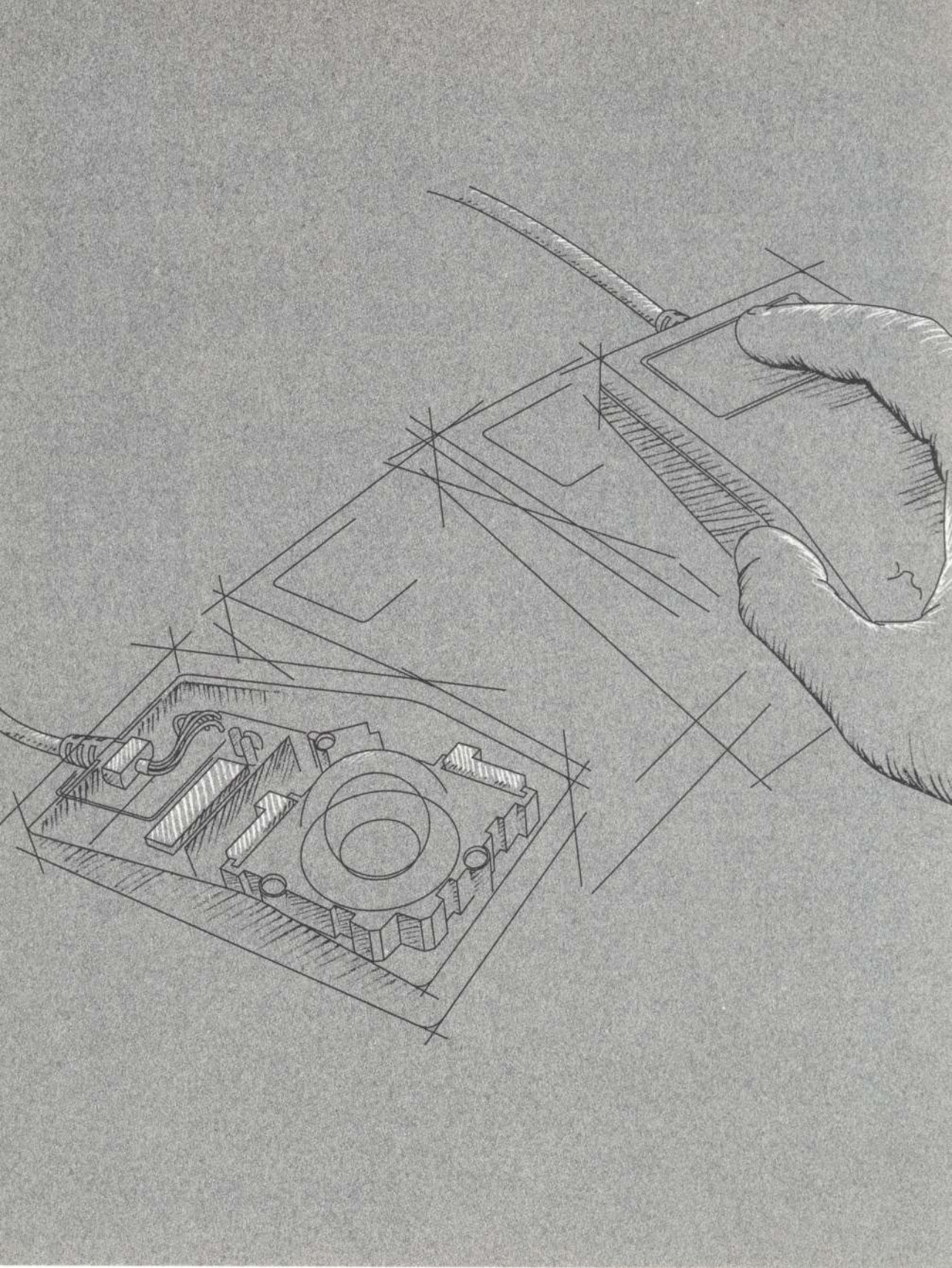
Macintosh keyboards include all the keys you'd normally find on a typewriter keyboard. You'll also find a built-in numeric keypad that lets you enter numbers and numeric symbols more quickly than by using the number keys on the top row of the main keyboard. (But most applications accept numbers and symbols from either the main keyboard or the numeric keypad.) The numeric keypad is especially useful when you use the Calculator desk accessory, a built-in calculator you can choose from the Apple menu.

In addition to character keys (that is, keys that produce text characters) there are special keys on Macintosh keyboards that allow you to produce alternate character sets or to duplicate actions you'd normally perform with the mouse. If you're accustomed to function keys on other types of computer keyboards, or if you just want to use keyboard shortcuts, you can use the special keys on the keyboard instead of the mouse for most operations. (For more information on special keys, see the *Macintosh System Software User's Guide.*)



Apple Extended Keyboard

Apple Keyboard



CHAPTER 3

How the Macintosh SE Works

IN CHAPTER 2, YOU LEARNED ABOUT THE HARDWARE COMPONENTS OF YOUR Macintosh SE computer. Another essential part of the computer system is software, the instructions that determine how the hardware will perform. This chapter provides a brief introduction to a particular type of software—system software—and then explains how Macintosh hardware and software work together.

System software

Of course, the Macintosh SE hardware is useless without software, the instructions programmed to make the machine perform its varied tasks. **System software** is one type of software: it's called *system software* because it's an essential collection of programs that the computer system needs before you can use it. It's also called *system software* to distinguish it from *application software,* the specific applications—word processing and spreadsheet applications, for instance—that you use to perform your work.

For a more detailed discussion of system software and the contents of the System Folder, see the *Macintosh System Software User's Guide.*

Though technically the routines in ROM are also considered system software, the phrase *system software* generally refers to a set of disk-based programs and files contained in a disk's **System Folder.** Among these programs and files are the System file, the Finder, and various resources.

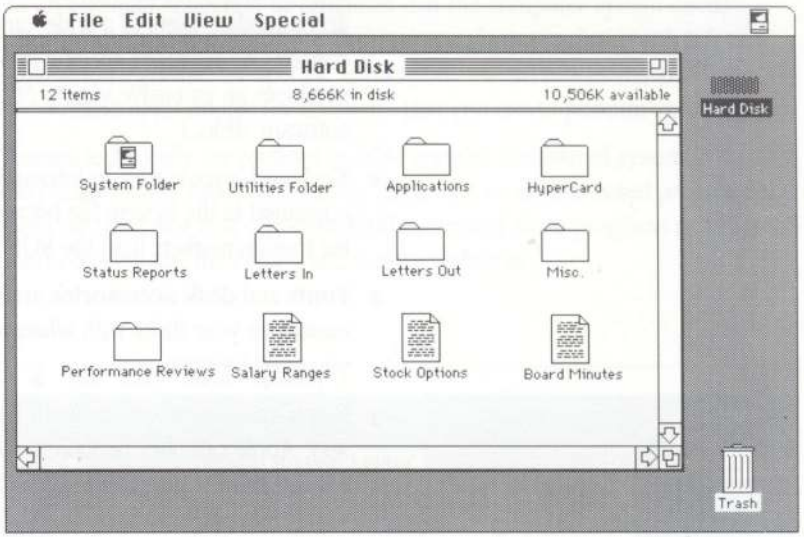
The System file

The contents of the **System file** are loaded into RAM automatically when you start up the computer. The System file contains important information that adds to or modifies the operating system routines in ROM:

- Messages that your computer uses to communicate with you need to be in a language you can understand. These messages are contained in the System file rather than in ROM so that the same computer can accommodate users of a wide variety of languages. (That is, the ROM contains no language-specific information. Instead, Apple Computer produces an extensive variety of foreign-language versions of its system software disks.)
- Keyboard layouts vary in international markets. This information is contained in the System file because it's more efficient to adapt a disk for foreign markets than the ROM itself.
- **Fonts** and **desk accessories** are kept in the System file so that you can customize your disks with whatever special fonts and desk accessories you need for your work.
- **Patch code** incorporates minor changes to the routines in ROM. That way, Apple can offer periodic ROM enhancements that you can take advantage of without having to upgrade the ROM chip itself. The routines in patch code are loaded into RAM when you start up the computer; they merely override the routines in ROM that they replace.

The Finder

The **Finder** is a special application that manages the Macintosh desktop; it is automatically loaded into RAM whenever you start up the computer. If you used the training disk, or the tutorial in the *Macintosh System Software User's Guide,* you've already been introduced to the Finder.



Along with the mouse, the Finder makes working with disks and their contents simple. Disks and files—usually applications, folders, and documents—are represented graphically in windows. As you've already seen, you use the pointer on the screen and the mouse button to work with icons, windows, and menus. You can perform almost all your disk and file functions just by pointing, clicking, and dragging, rather than by typing out lengthy commands.

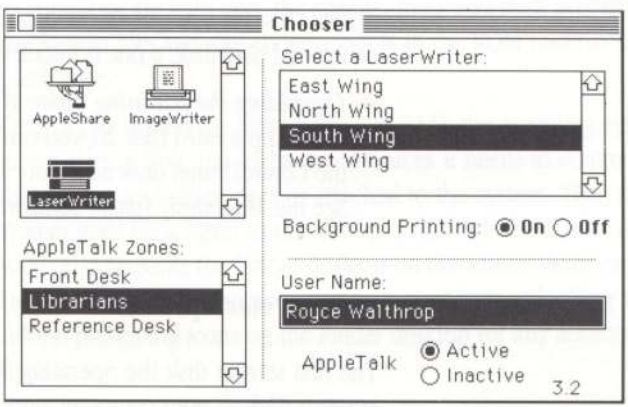
Resources

Resources are also sometimes referred to as *device drivers*.

Resources are files that contain information the microprocessor needs before it can communicate with devices attached to your computer system. For example, before you can print a document on a printer, the computer needs information about the type of printer you're using and how to communicate with it. This information is contained in **printer resources.** Other devices—such as plotters, scanners, file servers, and so on—require their own resources as well.

The resources in your System Folder determine the types of devices you can use with your Macintosh. When you start up the computer, the operating system notes which resources you have in the System Folder, and then lists them in the Chooser desk accessory window. Before you can print a document on a printer, for example, you must first use the Chooser (from the Apple menu) to indicate which printer you want and what port the printer is connected to.

For instructions on using the Chooser desk accessory, see the *Macintosh System Software User's Guide.*



Startup disks

Because the information in the System Folder is essential to the Macintosh operating system, your computer cannot complete its startup procedure without it. Accordingly, disks that contain a System Folder are called **startup disks.** It's possible to have more than one startup disk in your system's disk drives, but the computer will use only one to start itself up. When you switch on your computer, the operating system searches through the disk drives for a startup disk, and uses the System Folder on the first startup disk it finds to start itself.

Scanning order

In searching for a startup disk, the operating system scans the available disk drives in a particular order. First it looks in the lower internal disk drive. If it finds none there, it looks in the upper internal drive, if one is installed. Next it searches in any external non-SCSI drives (either 3.5-inch drives or external hard disk drives) connected through the disk drive port. Then it looks for SCSI drives—first for external drives connected through the SCSI port, and then an internal hard disk, if one is installed.

- *Overriding the scanning order:* If your system includes a SCSI hard disk or an Apple Hard Disk 20, you can override this scanning order by using the Control Panel desk accessory and choosing a specific startup device. See the *Macintosh System Software User's Guide* for details.

Current startup disk

The first startup disk the operating system finds becomes the **current startup disk.** If your computer system includes a hard disk, you'll probably find it most efficient to use the hard disk as the computer's startup disk, and use other disks for holding data. Occasionally, though, you'll want to use a 3.5-inch disk to start your system. That's why the operating system looks in the 3.5-inch drives before starting from the hard disk. In effect, the hard disk is the default startup disk: if it doesn't find a disk with a System Folder in any other drive, it uses the hard disk. (You'll learn more about startup disks in the *Macintosh System Software User's Guide.*)

How it works

The following sections provide a general description of how the hardware and software components of the Macintosh SE system work together.

Starting up the computer

When you switch on your Macintosh SE, the operating system determines how much memory space is present in RAM, performs some system diagnostic tests, and then begins scanning the disk drives for a startup disk.

When it identifies a startup disk, the operating system looks in the disk directory for the location of the System file, directs the disk drive's read/write heads to the appropriate sectors, and loads the essential parts of the System file into RAM.

With the core of the System file in RAM, the operating system now has all the information it needs about your keyboard layout, the messages it needs to communicate with you, the specific fonts and desk accessories installed in the System file, and any enhancements to the ROM routines in the form of patch code.

Once it has loaded the System file into RAM, the operating system goes back to the startup disk and loads the resources it needs to communicate with the printers and other devices attached to the system. Then the operating system goes back again to the startup disk, loads the Finder application into RAM, and presents the Finder desktop on the screen. After presenting an icon for the startup disk, the operating system continues looking in other disk drives, presenting icons on the Finder desktop for any additional disks it finds.

With the Finder loaded into RAM and the Finder desktop presented on the screen—showing icons for each of the disks in the system's drives—the system waits for an instruction from you to tell it what to do next. Normally, the instructions you give the computer are in the form of mouse operations (or sometimes keyboard instructions). For example, you might open a disk's icon by selecting the icon and choosing the Open command from the File menu. Or you may want to move or copy a document by dragging its icon. Each time you move the mouse, the operating system keeps track of the pointer's location on the screen and responds appropriately to your clicking the mouse button. More than likely, you'll want to perform some work using an application.

Starting up an application

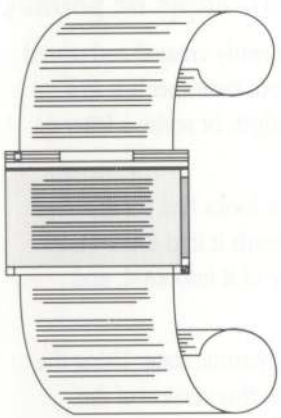
When you start up an application, the operating system goes to the disk directory to find the location of the application's instructions and loads them into RAM.

Depending on the size of the application, the operating system may load only part of the application's code into RAM at one time. While you're using the application, if you try to perform an action that requires parts of the program that are still on the disk, the operating system goes back to the disk and loads the necessary instructions into RAM, sometimes substituting them for code that's already been loaded for previous actions.

Creating a document from scratch

When you start up an application, most applications present an "Untitled" window, ready for you to begin typing text, drawing pictures, and so on. As you create a document, the operating system assigns specific locations in RAM for all the characters you type on the keyboard (or the art you create with the mouse), and displays what you create on the screen.

Because information in RAM is stored electronically, the document is in a very dynamic state: you can change the contents of the document, move parts from one place to another, delete them entirely, and generally create at your leisure until you've decided on its final form. Meanwhile, the application changes the electronic version of the document in RAM as you go along.



Depending on how much you create, the document you're working on may eventually become too large for you to see all of its contents on the screen at one time. In fact, there's quite a bit more room in RAM for a document than there is room on the screen to display it. As you continue creating, part of the document seems to move beyond the top or side of the screen to make room for the new material you're adding. Actually, the operating system is removing portions of your document from the screen buffer to make room for the new text or graphics.

To see the parts of the document that aren't displayed on the screen, you use the scroll arrows or the scroll bars. As you scroll, the operating system moves the appropriate portions of the document in and out of the screen buffer. This creates the effect of the document being moved under the application's window.

Saving your work

When you've finished working on a document, you'll probably want a permanent copy of it for safekeeping. To save a document on a disk, you choose the Save command from the File menu. This tells the operating system to create a file on the disk that will contain the document.

Once you give the document a name, and indicate which disk you want the document saved on, the operating system looks in the disk directory for free space in which to store the document. When it finds the space, it moves the disk drive's read/write heads to the available sectors and writes a copy of the electronic version of the document onto the disk's magnetic surface. Then the operating system makes an entry for the document in the disk directory and returns you to the electronic version still in RAM. With a copy of the document safely stored on the disk, you can close the document and free the space in RAM for other work.

Revising an existing document

You'll often need to return to documents you've already created and stored on a disk. For example, you may need to update your customer lists in a database, change some figures in a spreadsheet budget, or revise a letter or annual report.

When you open a document, the operating system looks first for the application you used to create the document and loads it into RAM. Then it finds the document you're opening, loads a copy of it into RAM, and presents the document on the screen.

Again, the copy of the document in RAM is in its dynamic state. Using the mouse and keyboard, you can make any changes to this version of the document that you want to, and the application changes the electronic version accordingly. Meanwhile, a copy of the original version of the document remains unaltered on the disk.

After you've finished revising the document, you have a choice of two ways to save it on the disk. You can save the revised document with the same name you gave the original; in this case, the operating system replaces the original version with the new one.

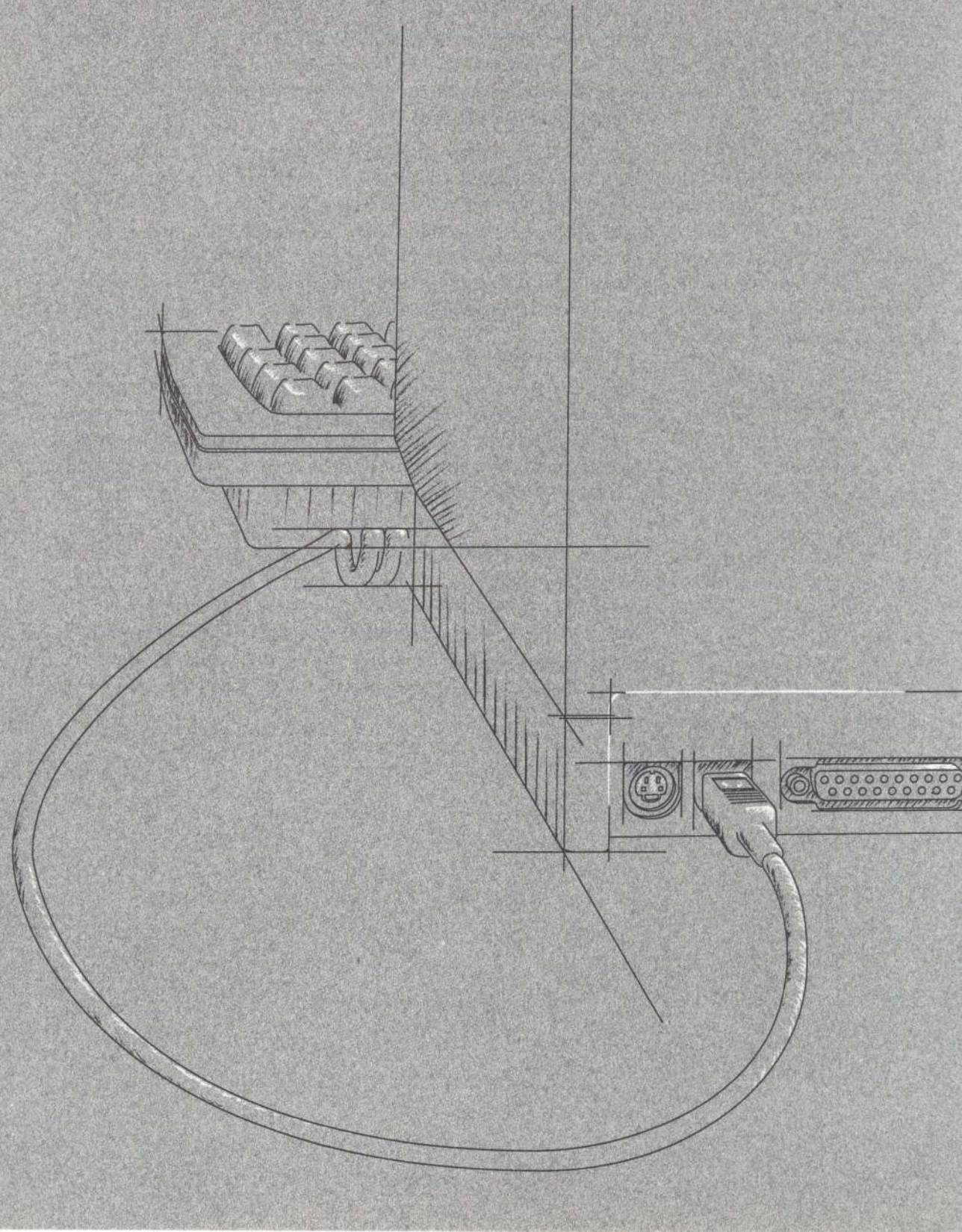
That's fine if you don't want to keep a separate copy of the original document. But you may want to save the revision and keep the original, too. For example, you may have a template document that you want to keep as an original and revise to create personalized versions. In this case, you give the revised document its own name, and the operating system creates a completely new file for the revised version: you have both the original document and the revised document on the disk.

Quitting an application

After you've saved your documents and are finished working with an application, you quit the application, usually by choosing the Quit command from the application's File menu. This merely directs the operating system to free the space in RAM that was occupied by the application's program code.

What's next?

In this chapter, you've only scratched the surface of how your computer works. If you're interested in learning more about the Macintosh SE, see Appendix D, "Guide to Technical Documentation." It describes other manuals you may want to investigate.



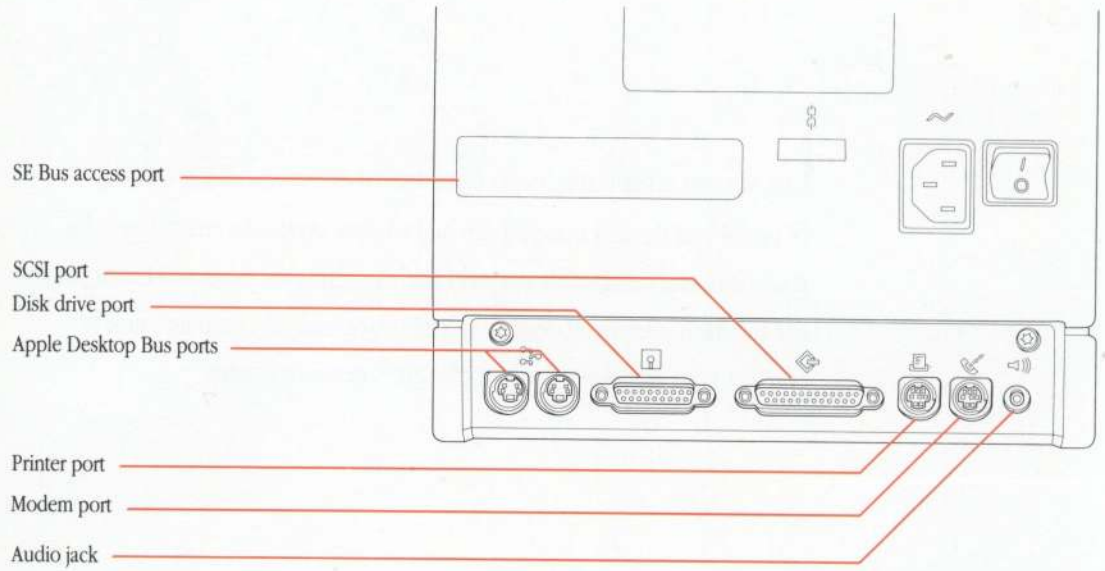
CHAPTER 4

Macintosh SE Ports and Buses

THE MACINTOSH SE COMPUTER IS DESIGNED TO ACCOMMODATE A VARIETY of peripheral devices that you can add to your system to customize it for your particular needs. This chapter briefly explains the ports and buses you'll use to attach peripheral devices to your Macintosh SE computer, and to connect your computer to an AppleTalk® network system.

Here is a brief summary of what you'll read about in this chapter:

- the Apple Desktop Bus
- the disk drive port
- the SCSI port
- the modem and printer ports
- the SE Bus
- the audio jack



The Apple Desktop Bus

A **bus** is a circuit that acts as a common connection for a number of devices.

You connect both the mouse and the keyboard to the computer through the **Apple Desktop Bus** (sometimes abbreviated *ADB*). Though all you normally need to operate the computer are the mouse and keyboard, the Apple Desktop Bus lets you connect a variety of devices concurrently, to customize your system to your particular needs. For instance, you could use a mouse, a keyboard, a track ball, and a graphics tablet all at once. Other devices you might connect to the Apple Desktop Bus ports include specialized keyboards or mouse devices, light pens, bar code readers, and so on.

The Macintosh SE provides two Apple Desktop Bus ports on its back panel. The Apple Keyboard and Apple Extended Keyboard include additional ports that you can use to daisy-chain devices. All these ports allow greater flexibility in connecting devices: you can attach them directly to the back-panel ports or daisy-chain them through the keyboard.

The number of devices that can be supported by the Apple Desktop Bus varies, depending on the power requirements of each device. Performance will probably deteriorate if more than three devices are daisy-chained to each of the computer's Apple Desktop Bus ports—giving an effective total of six devices.

See the "Apple Desktop Bus Power Requirements" section in Appendix B for more information on how many Apple Desktop Bus devices you should attach at one time.

The disk drive port

The Macintosh SE comes with either two internal 3.5-inch disk drives or one 3.5-inch drive and an internal hard disk; the **disk drive port** provides even more storage possibilities by letting you attach additional disk drives to your system. The disk drive port will accept another 3.5-inch drive, as well as most non-SCSI hard disks. (Some drives let you daisy-chain more than one drive through the disk drive port.) This is the same disk drive port as those found on earlier models of Macintosh computers, and will accept any type of disk drive used with those earlier models.

The SCSI port

SCSI (commonly pronounced "SKUH-zee") is an acronym that stands for *Small Computer System Interface*. SCSI is an industry-standard interface, defined by the American National Standards Institute (ANSI). The SCSI port is a **parallel communication** port that provides very high-speed data access for hard disks, tape backup systems, printers, and other devices. Because it uses an industry-standard interface, you can use many devices (with appropriate software) that would otherwise not be compatible with Apple computers.

Parallel communication means that the eight bits in each byte of data move along eight separate *parallel* lines inside a single cable.

The SCSI interface can communicate with up to seven SCSI devices daisy-chained through the SCSI port.

▲ Warning Connecting SCSI devices incorrectly can damage your computer. Appendix C, "Connecting SCSI Devices," provides important instructions for connecting SCSI devices to your system. Be sure to read the instructions *before* connecting any SCSI devices to your computer. ▲

AppleTalk

AppleTalk is Apple's network system for linking Apple computers with other workstations and devices on local- and wide-area networks. AppleTalk's network architecture is built into the Macintosh SE. The AppleTalk software is included with the system software on the *Macintosh System Tools* disk

Different types of cables can be used to link computers and other devices to form an AppleTalk network system. **LocalTalk** cables are one type; they provide a simple, easily installed, and very low-cost cabling system that lets you link up to 32 computers or devices together to form a local-area network. LocalTalk

The modem and printer ports

Serial communication means that the eight bits in each byte of data move single-file—*serially*—down one line inside a cable.

You use the **modem** and **printer ports** to attach modems, printers, and other **serial communication** devices to the Macintosh SE. Because they provide serial communication, these ports are sometimes referred to as the *serial* ports.

The two ports are almost identical; in practical terms, you can attach most serial devices to either port. There are two differences, however:

- The modem port has a higher interrupt priority than the printer port, which means that the microprocessor responds to signals from the modem port first. That's to ensure the constant contact between a modem and the microprocessor necessary for high-speed telecommunication.
- The **AppleTalk®** network system is designed to be supported primarily through the printer port. That means if you plan to connect your Macintosh SE to a **LocalTalk™** network, you'll need to use the printer port.

When you connect a device to either the modem or printer port, you also need to use the Chooser desk accessory from the Apple menu to confirm that choice: this gives the operating system the information it needs to communicate with the device.

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delivers all the benefits of multi-user communication and shared resources, and is the most cost-effective AppleTalk network system. Another AppleTalk network system is **EtherTalk™**. It is a high-speed alternative that uses the high-performance coaxial cables of an Ethernet network (a communications network widely used in the computer industry), and connects to EtherTalk interface cards installed in the SE Bus expansion connector in your computer. EtherTalk allows as many as 254 devices to be active on the network at one time, and more than a thousand can be connected to the same Ethernet cable.

For more information about AppleTalk, and the variety of AppleTalk network systems available for the Macintosh SE, ask your authorized Apple dealer or representative.

The SE Bus

The **SE Bus** is a direct data path to the microprocessor: it provides a 96-pin expansion connector inside the Macintosh SE designed for adding **expansion cards.** Expansion cards contain electronic circuits that implement specialized functions not otherwise supported by the Macintosh SE.

For instance, some cards speed up data processing or let you run MS-DOS applications; others contain the circuitry necessary for adding peripheral devices such as custom video displays, 5.25-inch disk drives, or adaptive devices for disabled users; still others provide capabilities for supporting communication networks such as Ethernet®.

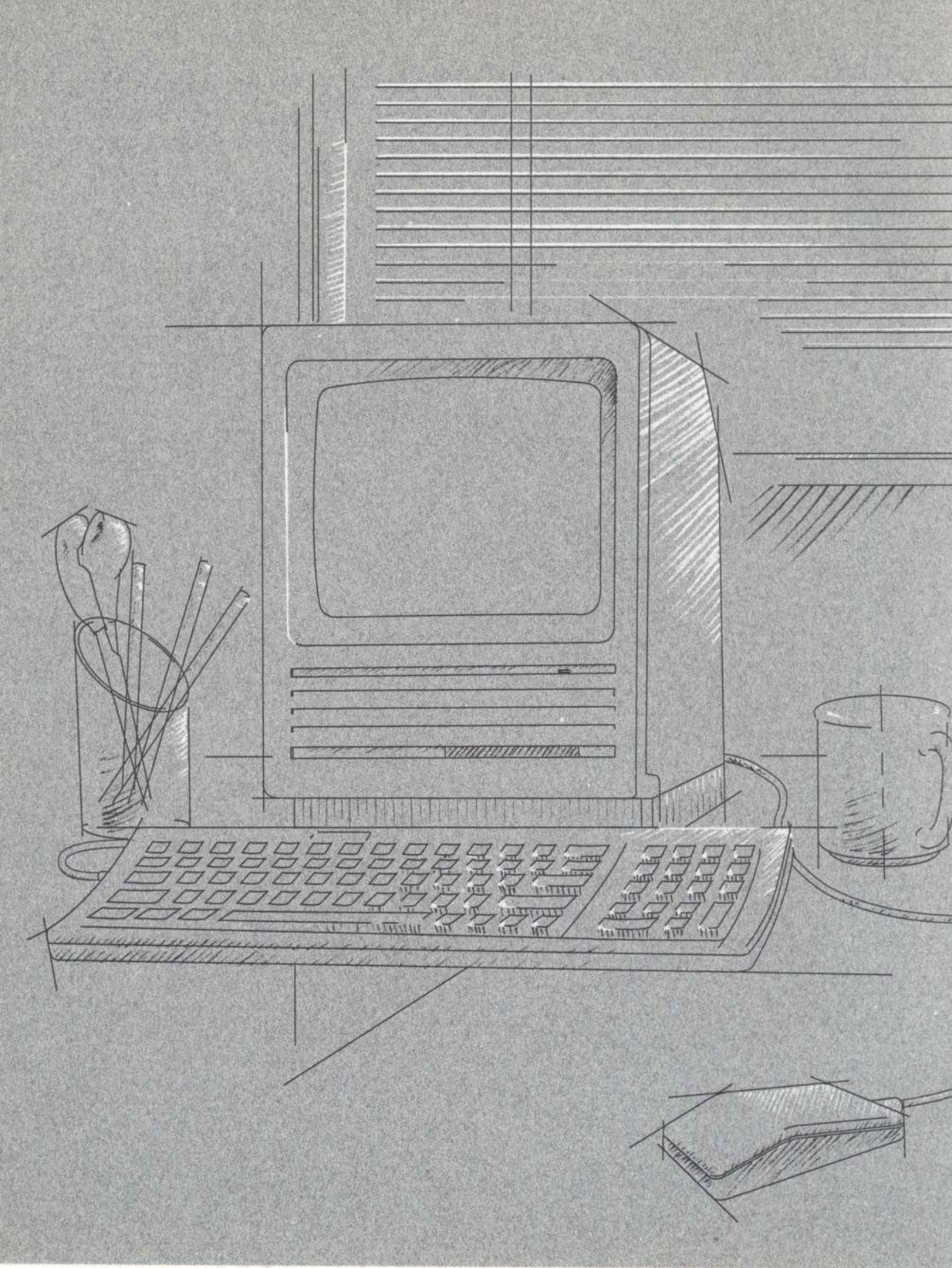
The **SE Bus access port** on the back panel of the Macintosh SE can be removed to mount connectors for peripheral devices that communicate through the SE Bus.

Because the expansion connector is inside the main unit, your authorized Apple dealer or representative must install any expansion card you want to add to your system.

▲ **Warning** Don't try to install an expansion card yourself. The Macintosh SE contains extremely high-voltage components that retain an electrical charge, even after the unit is switched off. Have your dealer install any expansion cards you want to add to your system. ▲

The audio jack

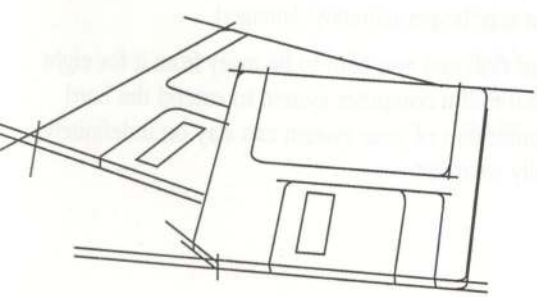
The Macintosh SE provides an **audio jack** on its back panel that lets you attach a variety of audio accessories—headphones, amplifiers, and other devices. The jack accepts a standard miniature phone plug, the type commonly found on portable cassette headphones.



C H A P T E R 5

Caring for Your Macintosh SE

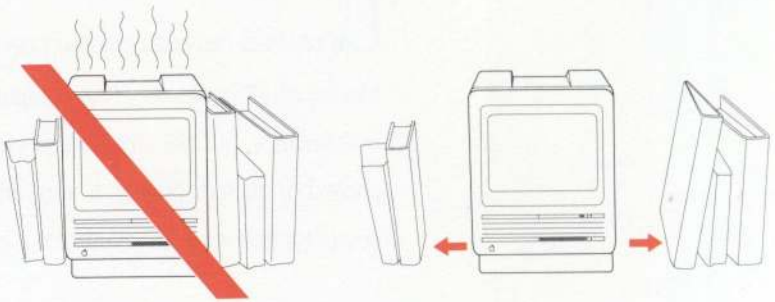
THIS CHAPTER PROVIDES INFORMATION ON HOW TO CARE FOR YOUR Macintosh SE computer. Your computer is sturdy and requires little physical maintenance. But like any piece of electrical equipment, it should not be abused or treated roughly. If you follow the few suggestions here, your computer will work efficiently for a long time.



The main unit

Give your Macintosh SE plenty of space—enough so air can circulate on all sides. Make sure air can circulate around each of the ventilation slots on the sides and back of the main unit. The computer has a built-in fan that maintains the operating temperature, but be sure not to block its outlet. You can store your Macintosh SE in a bookcase, but it shouldn't be crammed into a small space while you're using it.

△ Important Proper ventilation is important to the life of the computer. Be sure to leave at least a 4-inch to 6-inch clearance between the vents on the sides and back of the main unit and any object that might restrict air flow. △



The Macintosh SE can tolerate about the same range of temperatures as you can, but don't let it sit outside in direct sunlight or expose it to rain or moisture. The main unit will normally feel a bit warm to the touch after it's been on for a while.

If you choose to leave your computer on all the time, remember to turn down the brightness control when you're not using it; if your computer is left on for long periods (days or weeks), the image on the screen will start to "burn in," and the screen may be permanently damaged.

If your computer has a hard disk and you plan to be away from it for eight hours or more, shut off your entire computer system to extend the hard disk's life. While the computer part of your system can stay on indefinitely, the disk drive will eventually wear out.

Use common sense when handling your computer—especially if your system includes an internal hard disk. The hard disk can be damaged if the computer is dropped or bumped, particularly when the computer is on. If you need to transport the Macintosh SE any great distance, use the original packing materials. If your system includes an internal hard disk, the canvas cases manufactured for older Macintosh units are probably *not* sufficient protection.

Follow these suggestions if you need to clean the Macintosh SE:

- Clean the main unit with a *damp* (not wet) lint-free cloth.
- Don't use aerosol sprays, solvents, or abrasives that might damage the computer's finish.
- If the screen gets dirty, apply a household glass cleaner to a clean cloth or paper towel and wipe the screen. Don't spray glass cleaner directly onto the screen. It could run down inside the case and damage electrical circuits.

▲ Warning Never try to remove the cover of the main unit. The Macintosh SE contains extremely high-voltage components that retain an electrical charge, even after the unit is switched off. If you have a problem with the computer, bring it to your authorized Apple dealer or representative. ▲

The keyboard

Try not to spill anything on your keyboard. It can be ruined by a spilled soft drink or anything that leaves a sticky residue. Here's what to do if you spill something on the keyboard and it stops working:

- If the liquid is sweet or sticky, unplug the keyboard and take it to your authorized Apple dealer for repair or replacement.
- If the liquid is thin and clear, try unplugging the keyboard, turning it upside down to let the liquid drain out, and drying it for 24 hours at room temperature. If it still doesn't work, take it to your authorized Apple dealer.

The mouse

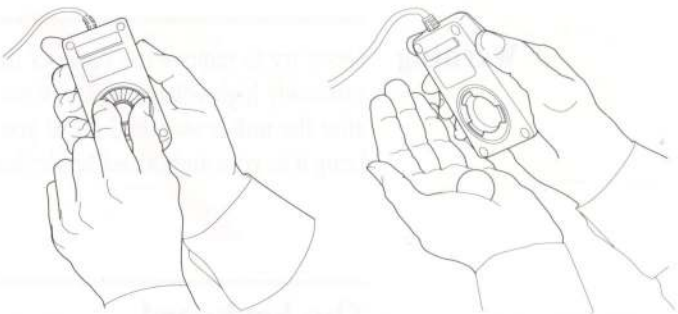
Be careful not to drop the mouse or let it hang from a table by its cable. Use common sense in treating it as carefully as you can.

The surface your mouse moves on should be as smooth, clean, and dust-free as possible. And give the mouse itself an occasional cleaning.

Here's how to clean the mouse:

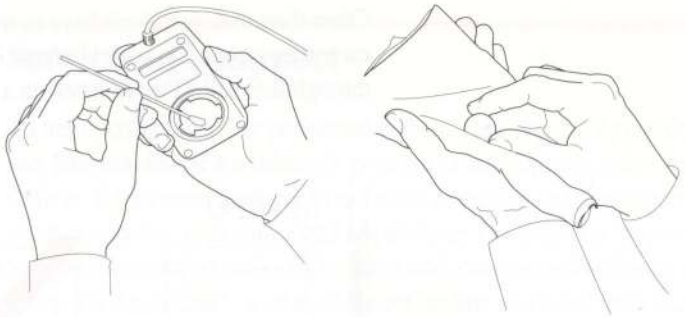
1. **Turn the mouse upside down and rotate the plastic dial counterclockwise as far as it will go.**

2. **Holding one hand over the ball and dial to catch them, turn the mouse back right side up. The dial and the ball will drop into your hand.**



3. **Inside the case are three plastic rollers, similar to those on a tape recorder. Using a cotton swab moistened with alcohol or tape head cleaner, gently wipe off any oil or dust that has collected on the rollers, rotating them to reach all surfaces.**

4. **Wipe the ball with a soft, clean, dry cloth. (Don't use tissue or anything that may leave lint, and don't use a cleaning liquid.)**



5. **Blow gently into the case to remove any dust that has collected there.**

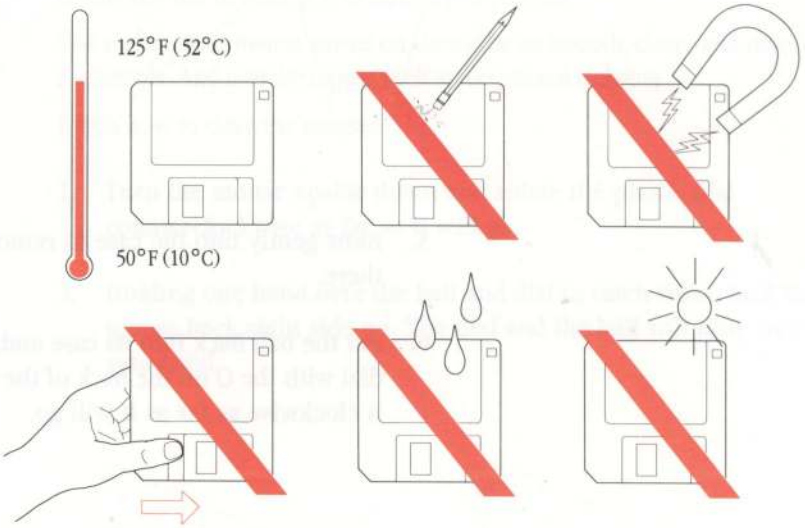
6. **Put the ball back into its case and, lining up the indicator on the dial with the O on the back of the case, reinsert the dial and turn it clockwise as far as it will go.**

3.5-inch disks

Although Apple 3.5-inch disks are quite tough, they do have a few modest physical requirements—about the same as audio cassette tapes have. Keep your Macintosh disks dry and away from extreme temperatures. (Don't put them on top of your Macintosh SE or store them on the seat of your car.) Keep them out of direct sunlight and out of reach of anything that contains a magnet, such as a telephone. (Magnetic fields can scramble the information on the disk.)

When the disk is inserted into the disk drive, the metal covering on the disk case slides to the left so the Macintosh SE can get information from and save information on the disk. When the disk is out of the disk drive, the metal covering closes by spring action to protect the disk underneath it. Never touch the exposed disk under the metal covering.

Other than that, you don't have to treat disks especially carefully. You can carry them around in your briefcase or coat pocket or even send them through the mail. (Two fit nicely in a business envelope.)



Be sure to make a backup copy of any disk you can't do without. (See the *Macintosh System Software User's Guide* for instructions on copying disks.)

You can purchase disks in packages of ten from your authorized Apple dealer.

The clock battery

Your Macintosh SE has a clock that runs continuously, even when the computer is switched off. (You can set the clock by choosing either Alarm Clock or Control Panel from the Apple menu.) When the computer's power is off, the clock runs on an internal lithium battery with a life expectancy of several years. If the clock begins to lose accuracy, see your authorized Apple dealer or representative for a battery replacement.

Service and support

To help you get the best performance from your system, Apple Computer, Inc. has established a worldwide network of full-support authorized Apple dealers. If you need answers to technical questions or information about product updates, your authorized Apple dealer can help you. Apple's Technical Support organization backs each dealer and international technical support group via AppleLink®, a state-of-the-art on-line electronic information service, to ensure prompt, reliable assistance.

Your dealer has the latest information on new hardware and software products as well as product updates. If you wish to upgrade your system, your dealer can help you select compatible components.

If your product requires service, your local authorized Apple dealer is trained and ready to support you. Apple provides factory-quality parts and the latest available diagnostic equipment to the more than three thousand authorized Apple service centers throughout the world. Apple guarantees parts and warranty labor. (Regulations in each country determine the length of the warranty. Some restrictions may apply, depending on the country of original purchase.)

If for some reason you cannot return to the authorized dealer from whom you purchased your system, go to the nearest service location. For the location nearest you, in the United States, call (800) 538-9696; in Canada, call (800) 268-7796 or (800) 268-7637. For locations in other countries, either call the Apple headquarters in your country or write to

Apple Computer, Inc.
Attn: Customer Relations
20525 Mariani Avenue
Cupertino, CA 95014
USA

or

Apple Canada, Inc.
7495 Birchmount Road
Markham, Ontario
L3R 5G2
Canada

Apple also offers service options designed to meet your needs. One of these is the Apple*Care*® Service Agreement (available in the United States, Canada, and Australia only), which extends full warranty coverage up to three years. Your Apple*Care* contract will be honored at any participating authorized Apple dealer within the country of purchase—an added benefit if you relocate. Local service means time saved in getting your Apple system back to work.

You can purchase Apple*Care* at any time, but it's a good idea to purchase it with your system, or at least before your warranty has expired, to avoid an owner-paid inspection.

There are also self-service plans designed to allow large installations to repair their own equipment. Whether you use your computer at home, in the office, or at school, Apple has a low-cost service plan for you. For details, please see your authorized Apple dealer.

APPENDIX A

The Macintosh Product Line

THIS APPENDIX SUMMARIZES THE DIFFERENCES BETWEEN THE VARIOUS MODELS of Macintosh computers. It is provided primarily for users who may be familiar with earlier models and who need a quick reference to the added features of newer Macintosh systems. The chart focuses primarily on hardware features; for a historical summary of the different versions of Macintosh system software, see the *Macintosh System Software User's Guide.*

	Macintosh (128K)	Macintosh 512K	Macintosh 512K Enhanced	Macintosh Plus	Macintosh SE	Macintosh II
Processor	MC68000 CPU	MC68000 CPU	MC68000 CPU	MC68000 CPU	MC68000 CPU	MC68020 CPU
Clock frequency	7.8336 MHz	7.8336 MHz	7.8336 MHz	7.8336 MHz	7.8336 MHz	15.6672 MHz
Addressing	32-bit internal registers 24-bit address bus	32-bit internal registers 24-bit address bus	32-bit internal registers 24-bit address bus	32-bit internal registers 24-bit address bus	32-bit internal registers 24-bit address bus	32-bit internal registers 32-bit address bus
Coprocessor	None	None	None	None	None built in. Accepts optional coprocessor card installed in internal SE Bus expansion connector.	Built-in MC68881 Floating-Point Unit (FPU). Accepts optional coprocessor cards installed in NuBus expansion slots.
ROM	64 KB	64 KB	128 KB	128 KB	256 KB	256 KB
RAM	128 KB	512 KB	512 KB	1 MB, 2MB, 2.5MB, or 4 MB	1 MB, 2MB, 2.5MB, or 4 MB	1 MB expandable to 8 MB (expandable to 128 MB when SIMMs with higher-density DRAM chips become available; additional expandability through NuBus slots)
Hardware memory management	None	None	None	None	None	Built-in 24/32-bit Address Mapping Unit (AMU) for address translation. Optional MC68851 Paged Memory Management Unit (PMMU).
Slot expansion	None	None	None	None	SE Bus expansion connector	Six NuBus expansion slots
Sound	RAM-based sound buffer Monophonic (Miniature phone plug)	RAM-based sound buffer Monophonic (Miniature phone plug)	RAM-based sound buffer Monophonic (Miniature phone plug)	RAM-based sound buffer Monophonic (Miniature phone plug)	RAM-based sound buffer Monophonic (Miniature phone plug)	Apple Sound Chip (ASC) Stereophonic (Miniature phone plug)

	Macintosh (128K)	Macintosh 512K	Macintosh 512K Enhanced	Macintosh Plus	Macintosh SE	Macintosh II
Internal 3.5-inch disk drive	400K	400K	800K	800K	800K Optional second 800K	800K Optional second 800K
External 3.5-inch disk drive	400K	400K	400K or 800K	400K or 800K	400K or 800K	Not supported
Hard disk	None	Optional external Hard Disk 20	Optional external Hard Disk 20	Optional external Hard Disk 20 Optional external SCSI hard disks	Optional external Hard Disk 20 Optional SCSI hard disks (internal/ external)	Optional SCSI hard disks (internal/ external)
SCSI	None	None	None	SCSI port (DB-25)	SCSI port (DB-25)	SCSI port (DB-25)
Serial ports	Two serial ports (DB-9)	Two serial ports (DB-9)	Two serial ports (DB-9)	Two serial ports (Mini-8)	Two serial ports (Mini-8)	Two serial ports (Mini-8)
Video display	Built-in 9-inch diagonal 512-by-342 pixel black-and-white monitor	Built-in 9-inch diagonal 512-by-342 pixel black-and-white monitor	Built-in 9-inch diagonal 512-by-342 pixel black-and-white monitor	Built-in 9-inch diagonal 512-by-342 pixel black-and-white monitor	Built-in 9-inch diagonal 512-by-342 pixel black-and-white monitor. Accepts optional external monitor connected through video card in SE Bus expansion connector.	Supports multiple external color and monochrome monitors connected through video cards in NuBus expansion slots.
Keyboard	Macintosh keyboard (RJ-11)	Macintosh keyboard (RJ-11)	Macintosh keyboard (RJ-11)	Macintosh Plus keyboard—includes numeric keypad (RJ-11)	Apple Keyboard or Apple Extended Keyboard connected through Apple Desktop Bus ports (Mini-4)	Apple Keyboard or Apple Extended Keyboard connected through Apple Desktop Bus ports (Mini-4)
Mouse	Macintosh Mouse connected through mouse port (DB-9)	Macintosh Mouse connected through mouse port (DB-9)	Macintosh Mouse connected through mouse port (DB-9)	Macintosh Mouse connected through mouse port (DB-9)	Apple Desktop Bus Mouse (Mini-4)	Apple Desktop Bus Mouse (Mini-4)

A P P E N D I X B

Technical Information

THIS APPENDIX PROVIDES SOME TECHNICAL INFORMATION ABOUT YOUR Macintosh SE computer. If you don't find the information you need, refer to Appendix D, "Guide to Technical Documentation." There you'll find a thorough discussion of the technical documentation available for Macintosh computers.

Here's a list of the sections you'll find in this appendix:

- specifications
- programmer's switch
- Apple Desktop Bus power requirements
- SIMM configurations
- pin assignments
- Macintosh peripheral cables

If you've used other types of Macintosh computers, Appendix A, "The Macintosh Product Line," will help you determine how the Macintosh SE differs from other models you may be familiar with.

Specifications

Processor:	MC68000, 32-bit internal architecture 7.8336 MHz clock frequency
Memory:	1 MB, 2 MB, 2.5 MB, or 4 MB RAM 256 KB ROM 256 bytes of user-settable parameter memory
Disk capacity:	800 KB on double-sided 3.5-inch floppy disks
	20, 40, or 80 MB optional Apple SCSI hard disks, internal and/or stand-alone (higher-capacity SCSI hard disks available from independent manufacturers)
Screen:	9-inch diagonal, high-resolution, 512-pixel by 342-pixel bitmapped display
Interfaces:	Two Apple Desktop Bus connectors for communication with keyboard, mouse, and other devices over low-speed, synchronous serial bus
	Two RS-232/RS-422 serial ports, 230.4K baud maximum (up to 0.920 Mbit per second if clocked externally)
	External disk interface
	Internal expansion connector (SE Bus connector)
	SCSI interface
	Sound port for external audio amplifier
Sound generator:	4-voice sound with 8-bit digital-analog conversion using 22 KHz sample rate

Input:	Line voltage: 120/240 volts AC, RMS Frequency: 47–63 Hz single phase Power: 100 watts maximum
Keyboards:	Apple Keyboard Apple Extended Keyboard
Mouse:	Apple Desktop Bus Mouse Mechanical tracking, optical shaft encoding 3.54 pulse per mm (90 pulse per inch) of travel
Clock/calendar:	CMOS custom chip with long-life lithium battery
Fan:	10 CFM axial

Environment

Operating temperature:	10° C to 40° C 50° F to 104° F
Storage temperature:	-40° C to 47° C -40° F to 116.6° F
Relative humidity:	5% to 95% (noncondensing)
Altitude:	0 to 3048 m (0 to 10,000 ft)

Size and weight

	Weight	Height	Width	Depth
Main unit	7.7–9.5 kg* 17–21 lbs*	345.4 mm 13.6 in	243.8 mm 9.6 in	276.2 mm 10.9 in
Apple Keyboard	1.0 kg 2 lbs 2 oz	44.5 mm 1.75 in	418.3 mm 16.5 in	142.0 mm 5.6 in
Apple Extended Keyboard	1.6 kg 3 lbs 10 oz	56.4 mm 2.25 in	486 mm 19.125 in	188 mm 7.4 in
Mouse	.17 kg 6 oz	27.9 mm 1.1 in	53.3 mm 2.1 in	96.5 mm 3.8 in

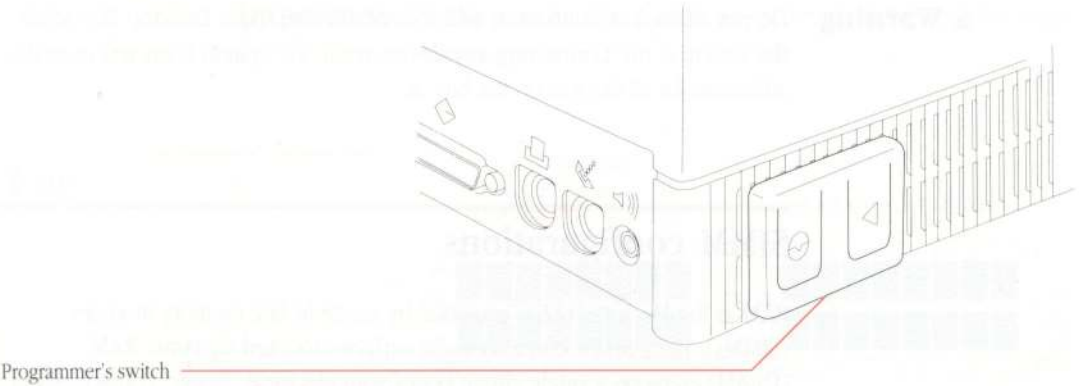
*Weight varies depending on installed optional hard disk or second 3.5-inch drive.

Programmer's switch

The programmer's switch that came packed with your computer is for people who want to write application programs for the Macintosh SE. If you aren't an applications developer, just ignore the switch. Installing it and using it in the wrong way could cause you to lose information.

If you are an applications developer, install the programmer's switch only if you're developing stand-alone applications or desk accessories. The switch has two parts. The front part of the switch is a reset switch. Pressing it is just like turning the power switch off and back on, and carries the same cautions—press it only in the Finder with all disks properly ejected. The back part of the switch is an interrupt switch; press it only if you have debugging software installed.

The switch snaps into place on the left side of the Macintosh SE.



Apple Desktop Bus power requirements

Although the Apple Desktop Bus can address up to 16 devices, performance will probably deteriorate if more than three devices are daisy-chained to each of the computer's Apple Desktop Bus ports (giving an effective total of six devices). Apple Desktop Bus devices may use the +5 volt power supplied by the bus, but must not draw more than 500 mA total for all devices. The mouse draws an average of 80 mA. The power needed by the keyboard varies, depending on which type of keyboard you have attached to your system:

Apple Keyboard	80 mA
Apple Extended Keyboard	25 mA

All devices are connected in parallel using the signal, power, and ground wires. Total cable length should be no longer than 5 meters, and cable capacitance should not exceed 100 picofarads per meter.

▲ Warning Do not attempt to connect or add a device to the Apple Desktop Bus while the system is on. Connecting any device while the system is on will reset the addresses for all devices on the bus. ▲

SIMM configurations

RAM in the Macintosh SE is provided by single in-line memory modules (SIMMs). Each SIMM contains eight surface-mounted dynamic RAM (DRAM) chips on a single circuit board with electrical "finger" contacts along one edge that plug into the SIMM sockets mounted on the computer's logic board. SIMMs can contain RAM chips with densities of either 256 Kbits or 1 Mbit.

▲ Warning Only qualified service personnel should open the computer's main unit. The Macintosh SE contains extremely high-voltage components that retain an electrical charge, even after the unit is switched off. Opening the main unit also voids the warranty. ▲

Four RAM configurations are available for the Macintosh SE, depending on how many SIMMs are used and on the density of the RAM chips that are mounted on the SIMMs. They are:

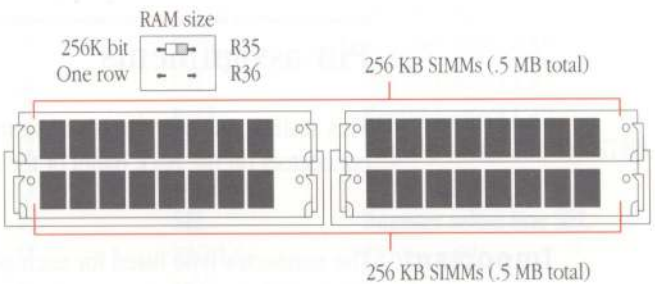
- 1 MB
- 2 MB
- 2.5 MB
- 4 MB

Some configurations—such as mixing RAM chips of different densities in a pair of SIMMs, or using only one SIMM in a row—are not allowed. If RAM chips of different densities are used, their placement in the SIMM sockets is critical. Use the following diagram for proper installation.

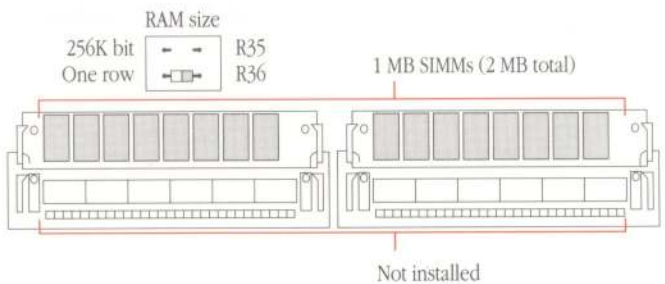
Note that the Macintosh SE logic board contains two resistors (in the area labeled "RAM SIZE") that must also be arranged correctly to correspond to the SIMM configuration installed.

△ Important SIMMs must be 150 nS RAM-access time or faster, and the same speed within a row. △

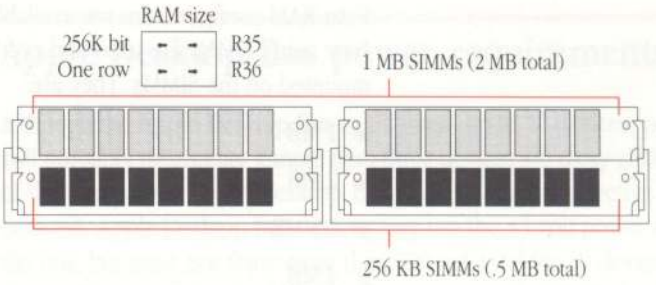
1 MB



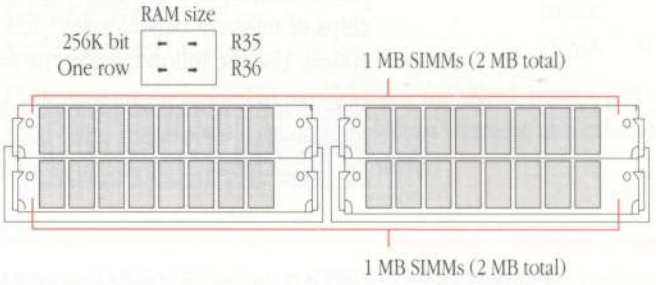
2 MB



2.5 MB



4 MB

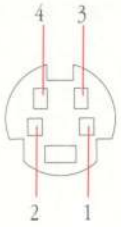


Pin assignments

This section presents the pin assignments and functions for all the external connectors on the back panel of the Macintosh SE.

△ **Important** The connector type listed for each port indicates the correct *plug* to use with the port illustrated in the margin. △

Apple Desktop Bus port

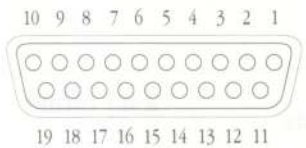


Pin number	Signal name	Signal description
1	ADB	Data
2	NC	Reserved
3	+5v	+5 volts DC
4	GND	Signal ground

Connector type: Mini-4

Total length of all cables not to exceed 16 feet (5 meters).

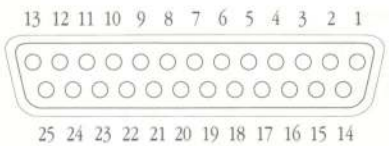
External disk drive port



Pin number	Signal name	Signal description
1	GND	Signal ground
2	GND	Signal ground
3	GND	Signal ground
4	GND	Signal ground
5	–12v	–12 volts DC
6	+5v	+5 volts DC
7	+12v	+12 volts DC
8	+12v	+12 volts DC
9	NC	No connection
10	PWM	Motor speed control
11	PH0	Register select CA0
12	PH1	Register select CA1
13	PH2	Register select CA2
14	PH3	Register write strobe LSTRB
15	WRREQ/	Write request
16	SEL	Register select line SEL
17	ENBL/	Drive enable
18	RD	Read data
19	WR	Write data

Connector type: DB-19

SCSI port



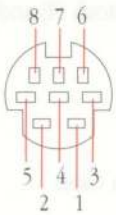
Pin number	Signal name	Signal description
1	REQ/	Request
2	MSG/	Message
3	I/O/	Input/Output
4	RST/	SCSI bus reset
5	ACK/	Acknowledge
6	BSY/	Busy
7	GND	Signal ground
8	DB0/	Data bit 0
9	GND	Signal ground
10	DB3/	Data bit 3
11	DB5/	Data bit 5
12	DB6/	Data bit 6
13	DB7/	Data bit 7
14	GND	Signal ground
15	C/D/	Command/Data
16	GND	Signal ground
17	ATN/	Attention
18	GND	Signal ground
19	SEL/	Select
20	DBP/	Data parity
21	DB1/	Data bit 1
22	DB2/	Data bit 2
23	DB4/	Data bit 4
24	GND	Signal ground
25	TPWR	Terminator power

Connector type: DB-25

Total length of all cables not to exceed 20 feet (6 meters).

▲ Warning This port uses the same type of connector as a standard RS-232 serial interface, but is electrically very different. Do not connect any RS-232 device to this connector. Doing so can result in damage to both the device and the Macintosh SE. ▲

Modem and printer ports



Pin number	Signal name	Signal description
1	HSKo	Handshake out
2	HSKi	Handshake in/external clock
3	TXD–	Transmit data –
4	GND	Signal ground
5	RXD–	Receive data –
6	TXD+	Transmit data +
7	GPi	General purpose input*
8	RXD+	Receive data +

Connector type: Mini-8

*Modem port only: Can be set in software to be a second external clock.

Audio jack

Pin number	Signal name	Signal description
(Sleeve)	GND	Signal ground
(Tip)	AUDIO	8 volt peak-to-peak audio signal

Connector type: Miniature mono phone plug

The internal speaker is disabled when this port is in use.

Macintosh peripheral cables

This table is a guide to the cables you should use with your Macintosh SE and peripheral devices.

Hard disks	Apple Hard Disk 20SC (DB-25)	M0206 Apple SCSI System Cable
	Apple Hard Disk 40SC (DB-25)	M0206 Apple SCSI System Cable
	Apple Hard Disk 80SC (DB-25)	M0206 Apple SCSI System Cable
Modems	Apple Personal Modem (Mini-8)	M0197 Apple System/ Peripheral-8 Cable
	Apple Modem 300/1200 (DB-9)	699-0372 Macintosh Plus Peripheral Adapter (use with existing cable)
	AppleFax™ Modem (Mini-8)	M0197 Apple System/ Peripheral-8 Cable

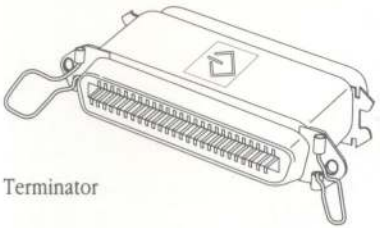
ImageWriter printers	ImageWriter® (DB-25)	699-0372 Macintosh Plus Peripheral Adapter (use with existing cable)
	ImageWriter II (Mini-8)	M0197 Apple System/ Peripheral-8 Cable
	ImageWriter LQ (Mini-8)	M0197 Apple System/ Peripheral-8 Cable
	AppleTalk ImageWriter II (Mini-8)	M2068 LocalTalk Locking Connector Kit DIN-8
LaserWriter printers	LaserWriter® (DB-9)	M2065 LocalTalk Locking Connector Kit DB-9
	LaserWriter Plus (DB-9)	M2065 LocalTalk Locking Connector Kit DB-9
	LaserWriter IINT (Mini-8)	M2068 LocalTalk Locking Connector Kit DIN-8
	LaserWriter IINTX (Mini-8)	M2068 LocalTalk Locking Connector Kit DIN-8
	LaserWriter IIsc (DB-25)	M0206 Apple SCSI System Cable

△ Important The Macintosh SE was FCC-certified under test conditions that included the use of shielded cables and connectors between system components. It is important that you use shielded cables and connectors to reduce the possibility of causing interference to radio, television, and other electronic devices. △

Connecting SCSI Devices

THIS APPENDIX PROVIDES INFORMATION YOU'LL NEED TO CONNECT SCSI devices to your Macintosh SE computer. You'll find instructions for assembling a SCSI chain and including the correct number of terminators. You'll also find instructions on setting the SCSI ID numbers on the devices you connect to your computer.

SCSI cables and terminators



Terminator

Devices connected to the SCSI port on the back of the main unit must have the proper number of **terminators** for the devices to work correctly and to prevent damage to the SCSI chip inside your computer.

Apple SCSI Cable Terminators are hardware devices that attach to a SCSI device or SCSI cable. There must be no more than two terminators in a SCSI chain—one at the start of the chain and one at the end.

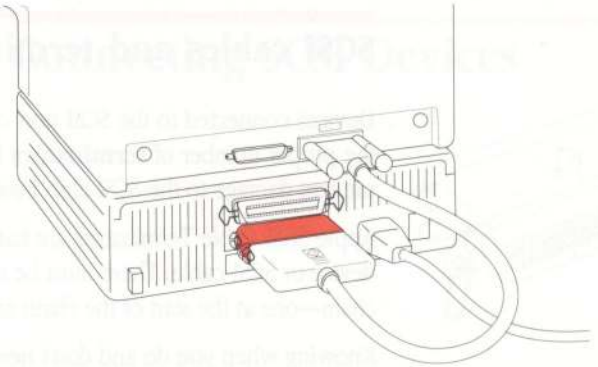
Knowing when you do and don't need a terminator can be confusing. Sometimes a terminator is inside a SCSI device where you can't see it, as with an internal hard disk. (The manual for the device should tell you whether it has a terminator.) Find the situation that applies to you in one of the following sections. In all cases, it's assumed that you're using Apple's 18-inch SCSI System Cable from your computer to the first SCSI device.

▲ Warning You can have no more than two terminators in the entire SCSI chain. More than two terminators in the chain may damage your computer.

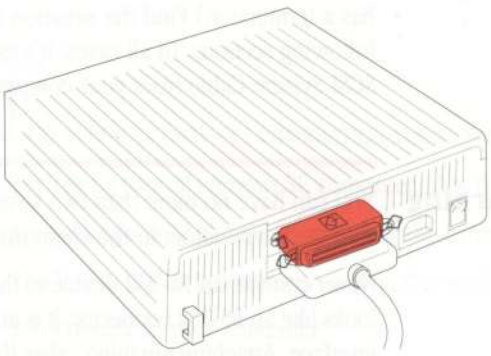
Never connect an RS-232 device to the SCSI port. Even though the SCSI port looks like an RS-232 connector, it is not a serial port or parallel printer interface. Attaching anything other than a SCSI device to the SCSI port can damage your computer.

If you're not sure what type of device you have, or whether it's OK to plug it in, ask a more experienced Macintosh user or contact your authorized Apple dealer or representative. ▲

Terminators are used in one of two ways in a SCSI chain. A terminator is either added between the SCSI System Cable and a SCSI connector, or added to the last available port on the SCSI device. Use the following diagrams in setting up your own SCSI chain.



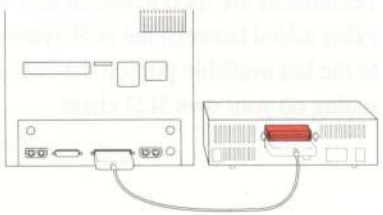
Terminator added between SCSI System Cable and SCSI connector



Terminator added to last available port

Connecting a single device

- If you are connecting an Apple device, or another device that does not contain a terminator, add a terminator to the last available port on the device.

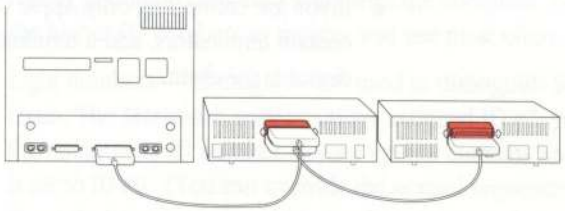


- If the device already contains a terminator, do not add one.

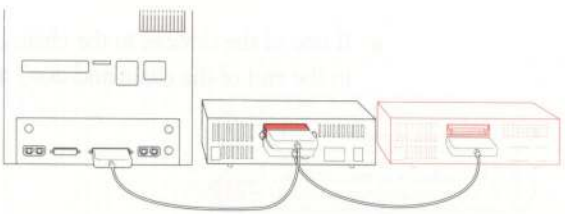
Connecting multiple devices

To systems without internal hard disks

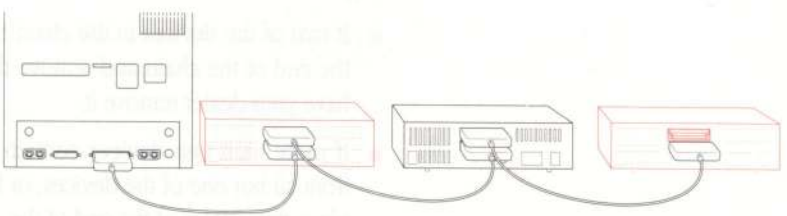
- If you are connecting only Apple devices, or other devices that do not contain terminators, add a terminator between the SCSI System Cable coming from your computer and the connector on the first device, and also add a terminator to the last available port on the last device in the chain.



- If one of the devices in the chain contains a terminator, place that device at the end of the chain and add a terminator between the SCSI System Cable coming from your computer and the connector on the first device.



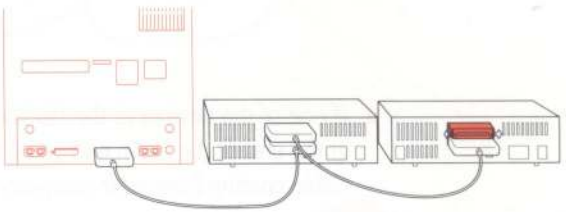
- If two of the devices in the chain contain terminators, place one device at the beginning of the chain and the other at the end of the chain, and don't add any terminators.



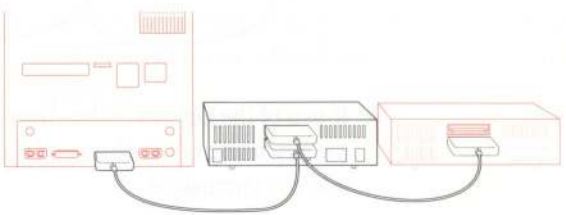
- If more than two devices in the chain contain terminators, remove the terminators from all but two of the devices, or have your dealer remove them. Then place one terminated device at the beginning of the chain and the other at the end of the chain.

To systems with internal hard disks

- If you are connecting only Apple devices, or other devices that do not contain terminators, add a terminator to the last available port on the last device in the chain.



- If one of the devices in the chain contains a terminator, move that device to the end of the chain and don't add any terminators.



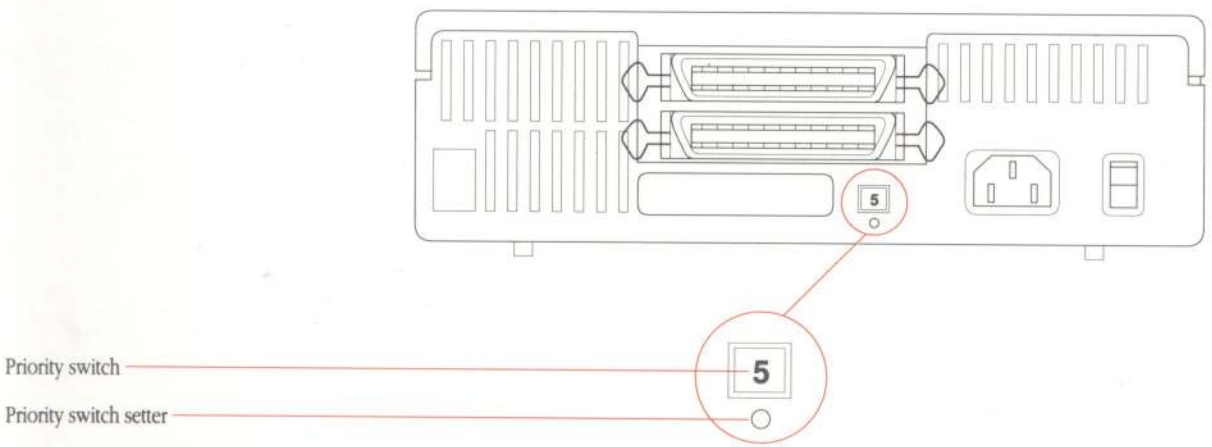
- If two of the devices in the chain contain a terminator, place one device at the end of the chain and remove the terminator from the other device, or have your dealer remove it.
- If more than two devices contain terminators, remove the terminators from all but one of the devices, or have your dealer remove them. Then place that device at the end of the chain.

Setting the SCSI ID numbers

Before you begin using the SCSI devices connected to your computer, you may need to set the SCSI ID number on each device. The computer uses the SCSI ID number to communicate correctly with the devices connected to it. Each device must have its own ID number. It identifies the device and assigns priorities on the SCSI chain; devices with higher ID numbers have higher priority in communicating with the computer. Generally, you assign the higher ID numbers to devices you use most often.

Eight numbers—7 through 0—are used to distinguish SCSI devices on the chain. The Macintosh itself is always assigned ID #7; you don't need to set the computer's ID number. If your system contains an internal hard disk, it is set to ID #0. (You can override the normal sequence by using the Control Panel desk accessory to select a preferred startup device.)

Apple SCSI peripheral devices are shipped with assigned SCSI ID numbers. The SCSI ID switch shows the ID number on the back panel of the device. If you don't have more than one of the same type of Apple SCSI device, you shouldn't need to set any ID numbers.



If you need to assign a different SCSI ID number to a device, follow these steps:

1. **Make sure the device is turned off.**
2. **Choose an unassigned SCSI ID number.**
3. **Insert the point of a push pin or straightened paperclip into the SCSI ID number switch.**
4. **Push gently.**

   The number increases.
5. **If you go past the number you want, keep pushing until the number cycles around to your choice.**

APPENDIX D

Guide to Technical Documentation

IF YOU NEED TECHNICAL INFORMATION THAT ISN'T INCLUDED IN THIS MANUAL, or if you're interested in learning more about the Macintosh family of computers, this appendix will direct you to the information you need.

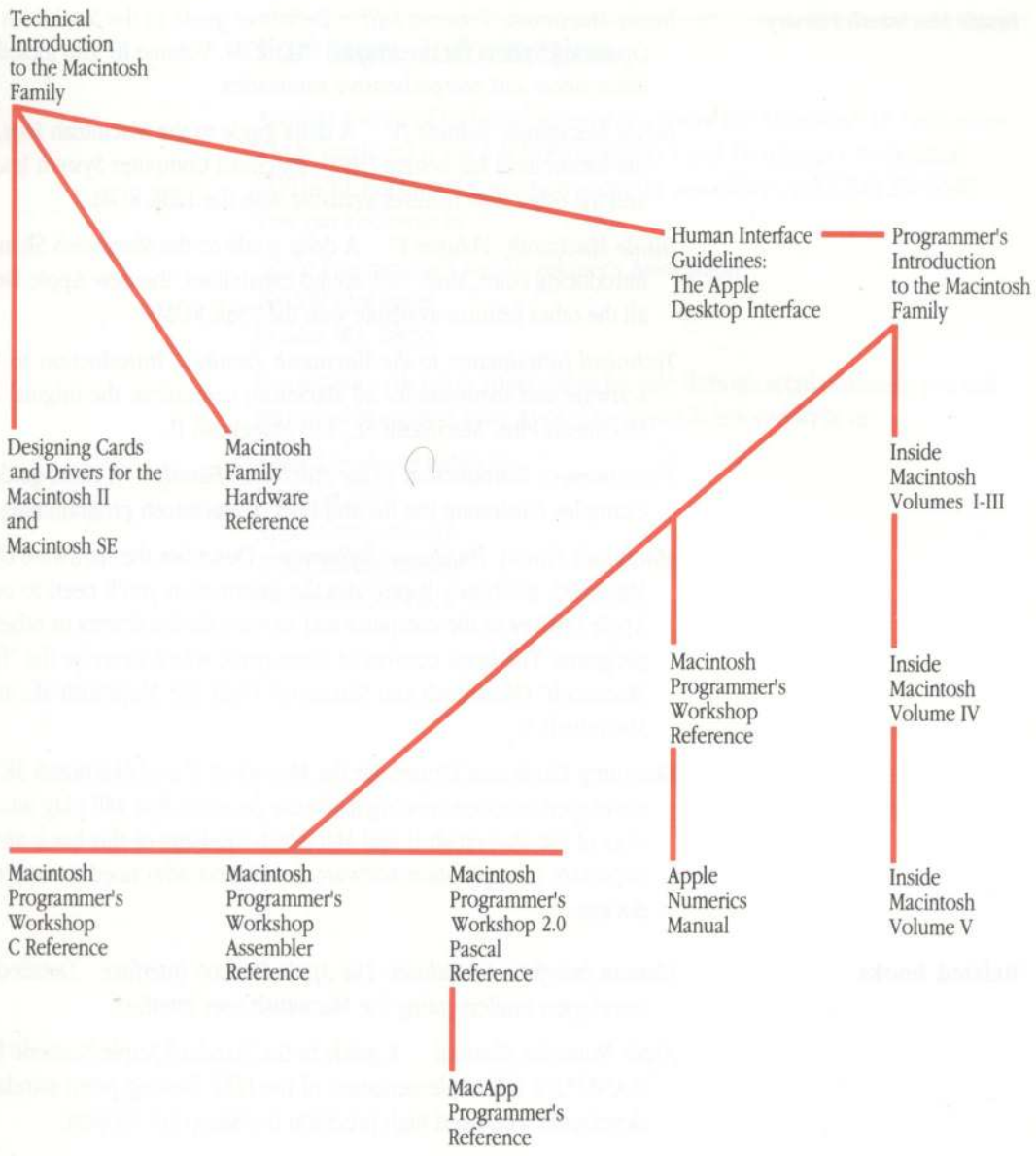
Technical documentation

The *Inside Macintosh Library* is a set of technical books that explain the hardware and software of the Macintosh family of computers. The *Inside Macintosh Library* is a part of the Apple Technical Library—a series of official technical publications from Apple Computer, and published by Addison-Wesley Publishing Company. You'll find the Apple Technical Library in most well-stocked bookstores.

The original Macintosh technical documentation consisted solely of *Inside Macintosh,* a three-volume compendium covering the Macintosh Toolbox and Operating System for the original 64K Macintosh ROM, together with user interface guidelines and hardware information. With the introduction of the Macintosh Plus (128K ROM), Volume IV of *Inside Macintosh* was released. A fifth volume has now been added, covering the Macintosh SE and Macintosh II computers (both containing 256K of ROM). Volumes IV and V are delta guides; that is, they explain only what is different about the new machines.

With the growth of the Macintosh family, the documentation set has also grown, and *Inside Macintosh* has now expanded into a whole family of books: the *Inside Macintosh Library.* These books contain the complete reference information for the entire Macintosh family.

The following diagram illustrates the relationship of the various components of the Macintosh documentation set. The diagram shows which manuals comprise the original *Inside Macintosh,* which comprise the new *Inside Macintosh Library,* and which are related to both sets of books. These books are described briefly in the bibliography that follows the diagram.


Technical Introduction to the Macintosh Family
Human Interface Guidelines: The Apple Desktop Interface
Programmer's Introduction to the Macintosh Family
Designing Cards and Drivers for the Macintosh II and Macintosh SE
Macintosh Family Hardware Reference
Inside Macintosh Volumes I-III
Macintosh Programmer's Workshop Reference
Inside Macintosh Volume IV
Macintosh Programmer's Workshop C Reference
Macintosh Programmer's Workshop Assembler Reference
Macintosh Programmer's Workshop 2.0 Pascal Reference
Apple Numerics Manual
Inside Macintosh Volume V
MacApp Programmer's Reference

***Inside Macintosh* Library**

Inside Macintosh, Volumes I–III Definitive guide to the Macintosh Toolbox and Operating System for the original 64K ROM. Volume III also includes hardware information and comprehensive summaries.

Inside Macintosh, Volume IV A delta guide to the Macintosh Plus, introducing the hierarchical file system (HFS), the Small Computer System Interface (SCSI), and the other new features available with the 128K ROM.

Inside Macintosh, Volume V A delta guide to the Macintosh SE and Macintosh II, introducing color, slots, new sound capabilities, the new Apple Desktop Bus, and all the other features available with the 256K ROM.

Technical Introduction to the Macintosh Family Introduction to the Macintosh software and hardware for all Macintosh computers: the original Macintosh, Macintosh Plus, Macintosh SE, and Macintosh II.

Programmer's Introduction to the Macintosh Family A short guide replete with examples illustrating the ins and outs of Macintosh programming.

Macintosh Family Hardware Reference Describes the hardware of the various Macintosh machines. It provides the information you'll need to connect non-Apple devices to the computer and to write device drivers or other low-level programs. The book consists of three parts, which describe the "Classic Macintosh" (Macintosh and Macintosh Plus), the Macintosh SE, and the Macintosh II.

Designing Cards and Drivers for the Macintosh II and Macintosh SE A guide for developers who are creating hardware products that will plug into the expansion slots of the Macintosh II and Macintosh SE. Parts of this book are also important to application software developers who need to understand slot devices.

Related books

Human Interface Guidelines: The Apple Desktop Interface Detailed guidelines for developers implementing the Macintosh user interface.

Apple Numerics Manual A guide to the Standard Apple Numeric Environment (SANE™), a full implementation of the IEEE floating-point standard, for developers who need high-precision floating-point support.

Macintosh Programmer's Workshop 2.0 Reference Description of the Macintosh Programmer's Workshop (MPW), Apple's software development environment for all Macintosh computers.

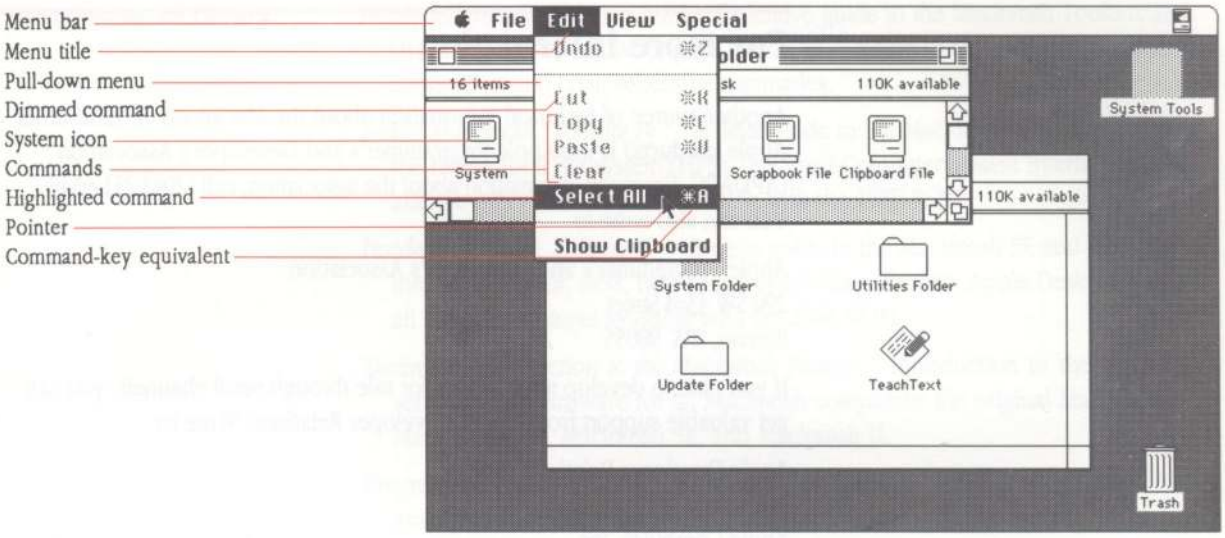
For more information

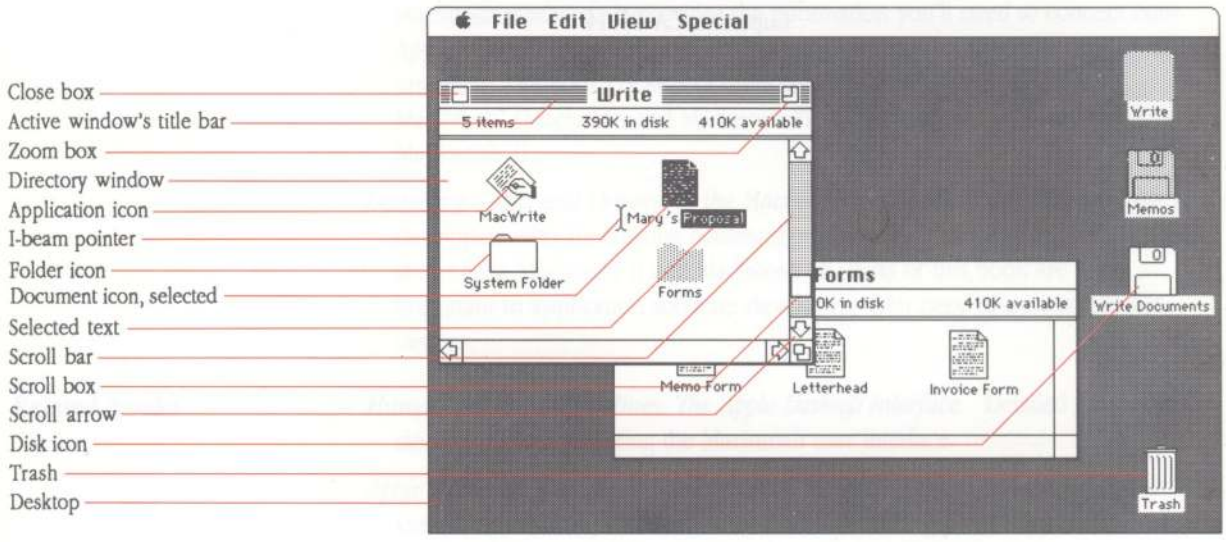
Another source of technical information about the Macintosh SE (and other Apple products) is the Apple Programmer's and Developer's Association (APDA™). For more information about the association, call (206) 251-6548. You can also write to

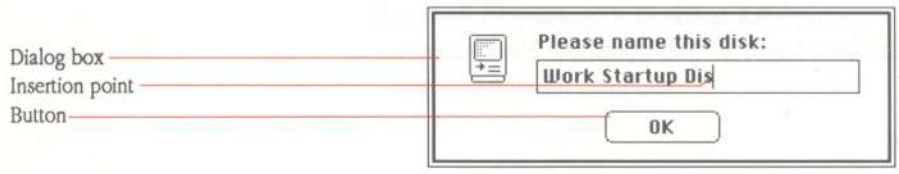
Apple Programmer's and Developer's Association
290 SW 43rd Street
Renton, WA 98055

If you plan to develop applications for sale through retail channels, you can get valuable support from Apple Developer Relations. Write to

Apple Developer Relations
Mailstop 27-W
Apple Computer, Inc.
20525 Mariani Avenue
Cupertino, CA 95014


Menu bar
Menu title
Pull-down menu
Dimmed command
System icon
Commands
Highlighted command
Pointer
Command-key equivalent
File
Edit
View
Special
Undo
Cut
Copy
Paste
Clear
Select All
Show Clipboard
16 items
System
110K available
Scrapbook File
Clipboard File
System Tools
System Folder
Utilities Folder
Update Folder
TeachText
Trash


Close box
Active window's title bar
Zoom box
Directory window
Application icon
I-beam pointer
Folder icon
Document icon, selected
Selected text
Scroll bar
Scroll box
Scroll arrow
Disk icon
Trash
Desktop
File
Edit
View
Special
Write
5 items
390K in disk
410K available
MacWrite
Mary's Proposal
System Folder
Forms
Memo Form
Letterhead
Invoice Form
Write
Memos
Write Documents
Trash


Dialog box
Insertion point
Button
Please name this disk:
Work Startup Dis
OK

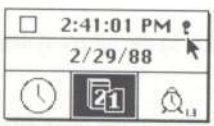
Glossary

accelerator card: An expansion card that contains another processor that shares the work normally performed only by the computer's main microprocessor. An accelerator card speeds up processing time.

active window: The frontmost window on the desktop; the window where the next action will take place. An active window's **title bar** is highlighted.

address: A number that specifies the location of a single byte of data in RAM.

address bus: The hardware path along which the addresses for specific memory locations are transmitted. The width of the path determines how much memory can be used (addressed) directly by the computer.

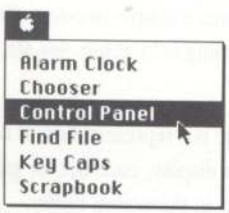


Alarm Clock: A **desk accessory** that displays the current date and time, and lets you set an alarm.

alert box: A box that appears on the screen to give a warning or to report an error message. The warning is accompanied by an alert sound.

Apple Desktop Bus (ADB): A low-speed serial bus with connectors on the back panel of the computer to which you attach the keyboard, mouse, and other Apple Desktop Bus devices, such as graphics tablets, hand controls, and specialized keyboards.

Apple HD SC Setup: A utility program that you use to initialize and test SCSI hard disks.



Apple menu: The menu farthest to the left in the menu bar, indicated by an Apple symbol, from which you choose **desk accessories.**

AppleTalk network system: The system of network software and hardware built into the computer and used in various implementations of Apple's communication networks.

application program: A program that performs a specific task, such as word processing, database management, or graphics—sometimes called an *application.*

arrow keys: The four directional keys on the keyboard that, when pressed, move the insertion point. Sometimes called *cursor keys.*

ASCII: Acronym for *American Standard Code for Information Interchange,* pronounced "ASK-ee." A standard used to represent text inside a computer and to transmit text between computers or between a computer and a peripheral device.

audio jack: A connector on the back panel of the computer to which you can attach headphones or other audio devices.

background printing: A type of background processing that lets you print documents in the background while using the computer to perform other work.

background processing: In multitasking environments, the operating system's ability to process lower-priority tasks while you perform other work on the computer.

Backspace key: A key that backspaces over and erases the previously typed character or the current selection. Its function is identical to that of the Delete key on newer Macintosh keyboards.

binary: Characterized by having two different components, or by having only two alternatives or values available; sometimes used synonymously with **binary system.**

binary digit: The smallest unit of information in the binary system; a 0 or a 1. Also called a **bit.**

binary system: A numbering system analogous to the more familiar decimal system, but using only 0 and 1 instead of 0 through nine, and each digit representing successive powers of two instead of ten. For example, the binary number 101011 is 43 in decimal. The binary system is useful because the values 0 and 1 can easily be represented in a variety of ways, such as the presence or absence of current, positive or negative voltage, or a white or black dot on the display screen. A single binary digit—0 or 1—is called a **bit.**

bit: A contraction of *binary digit.* The smallest unit of information that a computer can hold. The value of a bit (1 or 0) represents a simple two-way choice, such as yes or no, on or off, positive or negative, something or nothing. See also **binary system.**

bitmapped display: A display whose image is a representation of bits in an area of RAM called the **screen buffer.** With such a display, each dot, or **pixel,** on the screen corresponds, or is "mapped," to a bit in the screen buffer.

bridge: A device that lets you connect two or more networking systems together. See also **zone.**

bus: A path along which information is transmitted electronically within a computer. Buses connect computer devices, such as processors, expansion cards, input devices, and RAM. See **Apple Desktop Bus, NuBus,** and **SE Bus.**

button: A pushbutton-like image in dialog boxes where you click to designate, confirm, or cancel an action. Compare **mouse button.**

byte: A unit of information consisting of a fixed number of **bits.** A byte can represent any value between 0 and 255. The sequence of bits in a byte represents an instruction, letter, number, punctuation mark, or other character. Compare **gigabyte, kilobyte, megabyte.**

Calculator: A desk accessory that works like a four-function pocket calculator. Calculation results can be cut and pasted into your documents using the Edit menu.

Cancel button: A button that appears in a dialog box. Clicking it cancels the command.

Caps Lock key: A key that, when engaged, causes subsequently typed letters to appear in uppercase. It is like a Shift key that applies only to alphabetic characters.

character keys: Any of the keys on a computer keyboard—such as letters, numbers, symbols, and punctuation marks—used to generate text or to format text; any key except Shift, Caps Lock, Command, Option, Control, and Esc. Character keys repeat when you press and hold them down.

check box: A small box associated with an option in a dialog box. When you click the check box, you may change the option or affect related options.

chip: A term for *integrated circuit,* an electronic circuit entirely contained in a single piece of semiconducting material, usually silicon.

choose: To pick a command by dragging through a menu. You often choose a command after you've selected something for the application to act on; for example, selecting a disk and choosing the Open command from the File menu.

Chooser: A desk accessory that lets you configure your computer system to print on any printer for which there's a printing resource on the current startup disk. If you're part of an AppleTalk network system, you use the Chooser to connect and disconnect from the network and to choose among devices connected to the network. You can also specify a user name that the computer uses from time to time—when you're printing on a LaserWriter, for example.

Clear key: A key on the numeric keypad that clears the entry in the Calculator desk accessory and in applications that require numeric entry and calculations, such as spreadsheets.

click: To position the pointer on something, and then to press and quickly release the mouse button.

Clipboard: The holding place for what you last cut or copied. Information on the Clipboard can be inserted (pasted) into documents.

close: To turn a window back into the icon that represents it by choosing the Close command or by clicking the close box in the left corner of the window's title bar.

close box: The small white box on the left side of the title bar of an active window. Clicking it closes the window.

code: The statements or instructions that make up a computer program.

color wheel: A dialog box that appears when you click the Change Color button in the Control Panel desk accessory. The color wheel lets you adjust hue, saturation, and brightness.

command: A word or phrase, usually in a menu, describing an action for the computer to perform.

Command key: A key that, when held down while another key is pressed, causes a command to take effect. The Command key is marked with a propeller-shaped symbol. On some keyboards, the Command key has both the propeller symbol and an Apple symbol on it.

compatible: Capable of running without problems on the computer system. Applications are normally written to run on specific types of computers; applications that run on a computer system are said to be "compatible" with the computer.

configuration ROM: A chip on a NuBus expansion card that contains the information the computer's microprocessor needs to communicate with the card, or with peripheral devices attached to the card.

Control Panel: A desk accessory that you use to change the speaker volume, the keyboard repeat speed and delay, mouse tracking, and color display; set the system clock; create a RAM cache; and set other preferences.

convergence: An adjustment you make with an RGB color monitor to ensure that its red, green, and blue beams are aimed correctly for the best color picture. You can test your monitor's convergence by using the Control Panel desk accessory.

coprocessor: An auxiliary processor designed to relieve the demand on the main microprocessor by performing a few specific tasks. Coprocessors may favor a certain set of operations, such as floating-point calculations. Generally, coprocessors handle tasks that could be performed by the main microprocessor running appropriate software, but which would be performed much more slowly that way. Other coprocessors allow you to run software that would otherwise be incompatible with the computer's main microprocressor.

copy-protect: To make a disk uncopyable. Software publishers frequently copy-protect their disks to prevent them from being illegally duplicated by software pirates.

current startup disk: The disk that contains the System Folder the computer is currently using. The startup disk icon always appears in the upper-right corner of the Finder desktop.

cut: To remove something by selecting it and choosing Cut from a menu. What you cut is placed on the Clipboard. In other editing applications, delete serves the same function.

daisy-chain: To link together sequentially.

data: Information, especially information used or operated on by a program. The smallest unit of information a computer can understand is a **bit.**

data bus: The path along which data is transmitted within the computer. The wider the data bus, the more data can be transmitted at once.

Delete key: A key that moves the insertion point backward, removing the previously typed character, or that removes the current selection. Its function is identical to that of the Backspace key on some Macintosh keyboards.

desk accessories: "Mini-applications" that are available on the desktop from the Apple menu regardless of which application you're using. Examples are the Calculator, Alarm Clock, and Scrapbook.

desktop: Your working environment—the menu bar and the gray area on the screen. The desktop displays the Trash icon and the icons of any disks in the system's disk drives.

destination: The duplicate, as opposed to the original (or **source**), in making a copy of a document, folder, or disk.

dialog box: A box that contains a message requesting more information from you. Sometimes the message is a warning that you're asking your computer to do something it can't do, or that you're about to destroy some information. In these cases the message is often accompanied by a beep. See also **alert box.**

dimmed command: A command that appears gray rather than black in a menu bar because that command is unavailable at the moment. For example, in an application, the Cut command is dimmed unless you have selected a piece of text or graphics to cut.

dimmed icon: An icon that represents an opened disk or folder, or a disk that has been ejected. You can select and open dimmed disk icons, but you cannot open the documents on them.

directory: A pictorial, alphabetical, or chronological list of the contents of a folder or a disk.

directory dialog box: A type of dialog box you use to work in the hierarchical file system from within an application. Such dialog boxes appear whenever you choose the Open or Save As commands from within an application. See **hierarchical file system.**

directory window: A window that shows you the contents of a disk or folder.

disk: An information-storage medium consisting of a flat, circular, magnetic surface on which information can be recorded in the form of small magnetized spots, in a manner similar to the way sounds are recorded on tape. See **hard disk, 3.5-inch disk.**

disk buffer: An area in RAM used by the operating system as a temporary holding area before it saves the information on a disk.

disk capacity: The maximum amount of data a disk can hold, usually measured in kilobytes (K) or megabytes (MB). For instance, Apple 3.5-inch disks typically have a disk capacity of either 400K or 800K.

disk directory: An index of a disk's contents. It holds the names and locations of every file on its disk.

disk drive: The device that holds a disk, retrieves information from it, and saves information to it. A hard disk drive has the disk permanently encased. A 3.5-inch disk drive requires that you insert a 3.5-inch disk.

disk drive port: A port used to attach external disk drives to the Macintosh Plus and Macintosh SE.

document: Whatever you create with an application—information you enter, modify, view, or save.

dot pitch: A measure of the distance between dots on the screen. The closer the dots, the sharper and clearer the image.

double-click: To position the pointer where you want an action to take place, and then press and release the mouse button twice in quick succession without moving the mouse. Double-clicking is typically a quicker way of performing common tasks.

drag: To position the pointer on something, press and hold the mouse button, move the mouse, and release the mouse button.

Easy Access: A feature of system software that assists people who have difficulty typing with both hands on the keyboard, or manipulating the mouse. See **mouse keys, sticky keys.**

Enter key: A key that confirms an entry or sometimes a command.

ergonomics: The science of designing work environments that allow people and things to interact efficiently and safely. Sometimes called *human engineering.*

EtherTalk: A high-speed AppleTalk network system that uses the cables of an Ethernet network. Ethernet is a widely used communications network.

expansion card: A circuit board that implements specialized functions not otherwise supported by the computer. Expansion cards are installed in expansion connectors or expansion slots.

expansion connector: A connector inside the computer that lets you install an **expansion card** to enhance or extend the computer's performance.

file: Any collection of information stored on a disk—a document, a folder, a system file or resource, an application.

file server: A combination of controller software and a mass-storage device that allows computer users to share common files and applications through a network.

Finder: The application that maintains the Macintosh desktop and starts up other applications at the user's request. You use the Finder to manage documents and applications, and to get information to and from disks.

Find File: A desk accessory that lets you find any folder or file on a disk.

firmware: Software instructions contained in the Macintosh ROM. Firmware is permanent and unchangeable.

floating-point unit (FPU): See **Motorola 68881.**

folder: A holder of documents, applications, and other folders on the desktop. Folders allow you to organize information in any way you want.

font: A complete set of characters in one design, size, and style. Geneva 9-point Italic is an example of a Macintosh font.

Font/DA Mover: A utility program that lets you add or remove fonts and desk accessories in your System file.

gigabyte (GB): A unit of measurement equal to 1024 (2^{10}) megabytes. Compare **byte, kilobyte, megabyte.**

gray scale: Shades of gray on the screen that are created by varying the intensity of the screen's pixels, rather than by using a combination of only black and white pixels to produce shading.

hard disk: A disk made of metal and sealed into a drive or cartridge. A hard disk can store very large amounts of information compared with 3.5-inch disks.

hardware: In computer terminology, the machinery that makes up a computer system. Compare **firmware, software.**

hierarchical file system (HFS): A feature of system software that lets you use folders to organize documents, applications, and other folders on a disk. Folders (analogous to subdirectories in other systems) can be nested in other folders to create as many levels as you need.

highlight: To make something visually distinct from its background, usually to show that it has been selected or chosen.

I-beam: A type of pointer used in entering and editing text.

icon: A graphic representation of an object, a concept, or a message, usually used to represent disks, applications, folders, documents, and so on.

initialize: To prepare a disk to receive information. Initializing a disk divides its surface into **tracks** and **sectors,** which the operating system uses to keep track of the contents of the disk.

input device: A device that sends information to the microprocessor. The mouse and keyboard are the Macintosh's primary input devices. Compare **output device.**

insertion point: The place in a document where something will be added. You set an insertion point by clicking. It is represented by a blinking vertical bar.

Installer: A utility program that lets you choose an Installation script for updating your system software.

instruction set: The complete range of instructions a microprocessor can interpret. Each brand of microprocessor has its own instruction set.

K: See **kilobyte.**

Keyboard shortcut: A keystroke that you can use instead of a mouse action to perform a task. For example, pressing the Command and the X keys at the same time is the same as choosing the Cut command from the Edit menu.

Key Caps: A desk accessory that shows you the optional character set available for a given font family.

kilobyte (KB): A unit of measurement consisting of 1024 (2^{10}) bytes. Often abbreviated *K*. Compare **byte, gigabyte, megabyte.**

local-area network (LAN): A group of computers connected for the purpose of sharing resources. The computers on a local-area network are typically joined by a single transmission cable, and are located within a small area such as a single building or section of a building.

LocalTalk: A low-cost AppleTalk network system that lets you link up to 32 computers or devices together to form a local-area network.

lock: To prevent documents from being edited, discarded, or renamed, or to prevent entire disks from being altered. Compare **write-protect.**

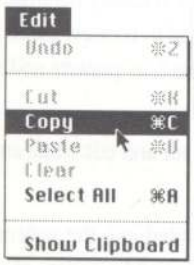
Macintosh Operating System: The combination of ROM-based and disk-based routines that together perform basic tasks such as starting the computer, moving data to and from disks and peripheral devices, and managing memory space in RAM.

Macintosh User Interface: The standard conventions for interacting with Macintosh computers. The interface ensures users a consistent means of interacting with all Macintosh computers and the applications designed to run on them.

main unit: The computer console, which contains the processor, memory, the built-in disk drive(s), the optional internal hard disk, and, on the Macintosh Plus and SE, the screen.

megabyte (MB): A unit of measurement equal to 1024 (2^{10}) kilobytes. Compare **byte, gigabyte, kilobyte.**

memory: The place in the computer's main unit that stores information. Macintosh computers include a minimum of 1 megabyte of RAM (random-access memory) that you can use for your work, and 256K of ROM (read-only memory) that stores certain system information permanently. See also **RAM** and **ROM.**



menu: A list of commands that appears when you point to and press the menu title in the menu bar. Dragging through the menu and releasing the mouse button while a command is highlighted chooses that command.

menu bar: The horizontal strip at the top of the screen that contains menu titles.

menu title: A word or phrase in the menu bar that designates one menu. Pressing on the menu title causes the title to be highlighted and its menu to appear below it.

microprocessor: An integrated circuit on the computer's main circuit board. The microprocessor carries out software instructions by directing the flow of electrical impulses through the computer.

modem port: One of two **serial communication** ports on the back panel of the computer.

Motorola 68000: The microprocessor in the Macintosh Plus and SE computers.

Motorola 68020: The microprocessor in the Macintosh II. The Motorola 68020 can also be added to the Macintosh SE by means of an accelerator card installed in the SE Bus expansion connector.

Motorola 68851: An optional coprocessor available for the Macintosh II that allows paged memory management, a technique that lets the microprocessor access a much larger body of data than can fit in RAM at one time. Sometimes referred to as the *Paged Memory Management Unit,* or *PMMU.*

Motorola 68881: A coprocessor chip that provides high-speed support for processing scientific computations. Sometimes also referred to as the *floating-point unit,* or *FPU.*

mouse: The small mechanical device whose movement on your desk corresponds to pointer movements on your screen.

mouse button: The button on the top of the mouse. In general, pressing the mouse button initiates some action on whatever is under the pointer, and releasing the button confirms the action.

mouse keys: An Easy Access feature that lets you manipulate the pointer using the 10-key numeric keypad instead of the mouse. See **Easy Access.**

MultiFinder: A multitasking operating system for Macintosh computers that makes it possible to have several applications open at the same time, including background applications that let you perform one task while the computer performs another.

nesting: Placing folders inside other folders. See **hierarchical file system.**

network: A collection of interconnected, individually controlled computers, together with the hardware and software used to connect them. A network allows users to share data and peripheral devices such as printers and storage media, to exchange electronic mail, and so on.

Note Pad: A desk accessory that lets you enter and edit small amounts of text while working on another document.

NuBus: An **address** and **data bus** incorporated into the system architecture of the Macintosh II. The NuBus architecture lets you add a variety of components to the system, by means of **expansion cards** installed in **NuBus expansion slots** inside the Macintosh II.

NuBus expansion slots: The six slots on the main circuit board of the Macintosh II to which you add cards for video monitors and peripheral devices, coprocessors, and network interfaces. See **expansion card.**

numeric keypad: The set of keys on the right side of the keyboard that let you enter numbers and perform calculations quickly.

numeric keys: See **numeric keypad.**

open: To create a window from an icon so you can view a document or directory.

open architecture: A computer system's ability to use a variety of optional components designed to meet specialized needs, such as video, coprocessing, networking, and so on. An "open" system is one to which a user with no technical background can easily add devices and expansion cards to customize the system.

operating system: See **Macintosh Operating System.**

Option key: A key used to give an alternate interpretation to another key you type. You use it to type international characters or special symbols.

output device: A device that receives information from the microprocessor. The monitor is the Macintosh's primary output device. Compare **input device.**

Paged Memory Management Unit (PMMU): See **Motorola 68851.**

parallel communication: A form of data communication in which the eight bits in each byte of data move along eight separate parallel lines inside a single cable.

paste: To put a copy of the contents of the Clipboard—whatever was last cut or copied—at the insertion point.

patch code: Software instructions contained in the System file that override some routines in ROM. Patch code is used for periodic upgrades of ROM routines.

peripheral device: A piece of computer hardware—such as a disk drive, printer, or modem—used in conjunction with a computer and under the computer's control. Peripheral devices are usually physically separate from the computer and connected to it by wires or cables.

pixel: An individual dot on the screen. With a simple monochrome video display, a pixel is the visual representation of a single bit in the screen buffer (white if the bit is 0, black if it is 1). With color or gray-scale video displays, each pixel on the screen may represent several bits.

plain-text documents: Documents consisting only of readable ASCII characters, without any formatting codes specific to a particular full-feature word processing application.

pointer: A small shape on the screen, most often an arrow pointing up and to the left, that follows the movement of the mouse.

port: A socket on the back panel of the computer where you can plug in a cable to connect a peripheral device, another computer, or a network.

Power On key: A key on the keyboard that starts the Macintosh II.

press: To position the pointer on something and then hold down the mouse button without moving the mouse.

PrintMonitor: An application that monitors background printing and provides options intended to give you additional control over what happens to documents you are printing. See **background processing.**

printer port: One of two **serial communication** ports on the back panel of the computer.

printer resource: A file in the System Folder that provides information the microprocessor needs to communicate with a printer.

RAM: An acronym for *random-access memory,* the memory chips that store information temporarily while you're working on it. RAM can contain both application programs and your own information. Information in RAM is temporary, gone forever if you switch the power off. See also **ROM.**

RAM cache: RAM you can designate to store certain information an application uses repeatedly. Using the RAM cache can greatly speed up your work, but may need to be used sparingly or not at all with applications that require large amounts of memory. You set the RAM cache in the Control Panel.

Read Me documents: Plain-text documents that are included on application and system software disks to provide you with late-breaking information about the product. You'll usually find Read Me documents in the Update Folder on the disk.

read-only memory: See **ROM.**

register: A location in a processor or other chip where an item of information is held and modified by a program.

resources: Files contained in the System Folder that provide information the microprocessor needs to communicate with devices attached to the computer system.

Return key: A key that makes the insertion point move to the beginning of the next line. It's sometimes used to confirm or terminate an entry or a command.

ROM: An acronym for *read-only memory,* the memory chips that contain information the computer uses (along with system files) throughout the system, including the information it needs to get itself started. Information in ROM is permanent; it doesn't vanish when you switch the power off. See also **RAM.**

routine: A sequence of software instructions.

save: To store information from RAM onto a disk.

scanning order: The order in which the operating system scans the disk drives looking for a startup disk.

Scrapbook: A desk accessory in which you can save frequently used pictures and text.

screen buffer: A portion of memory in RAM from which the video display reads the information to be displayed on the screen.

scroll: To move the contents of a window, or a list in a dialog box, by means of the scroll bar or scroll arrows.

scroll arrow: An arrow on either end of a scroll bar. Clicking a scroll arrow moves the document or directory one line. Pressing a scroll arrow scrolls the document continuously.

scroll bar: A rectangular bar that may be along the right or bottom of a window. Clicking or dragging in the scroll bar causes the view of the document to change.

scroll box: The white box in a scroll bar. The position of the scroll box in the scroll bar indicates the position of what's in the window relative to the entire document.

SCSI: An acronym for *Small Computer System Interface,* an industry standard interface that provides high-speed access to peripheral devices.

SCSI port: The port on the back panel of the computer to which you connect SCSI devices.

SE Bus: A direct data path to the microprocessor, implemented through a 96-pin expansion connector inside the Macintosh SE. Expansion cards for the SE Bus include accelerator cards and coprocessor cards.

SE Bus access port: An insert on the back panel of the Macintosh SE that allows access to the SE Bus expansion connector inside the computer. Used only for cables that run between an **expansion card** and a **peripheral device.**

sector: A part of a track on the surface of a disk. When a disk is first initialized, the operating system divides the disk's surface into circular tracks, with each track divided into sectors. Tracks and sectors are used to organize the information stored on a disk.

select: To designate where the next action will take place. To select, you click or drag across information.

selection: The information affected by the next command. The selection is usually highlighted.

serial communication: A form of data communication in which the eight bits in each byte of data move single-file—serially—down one line inside a cable.

serial interface: An interface in which information is transmitted sequentially, one bit at a time, over a single wire or channel.

serial ports: The connectors on the back panel of the computer for devices that use a **serial interface.** See also **modem port** and **printer port.**

Shift-click: A technique that lets you extend or shorten a selection by holding down the Shift key while you select (or deselect) something related to the current selection.

Shift key: A key that, when pressed, causes subsequently typed letters to appear in uppercase, and causes the upper symbol to appear when number or symbol keys are typed.

SIMM: An acronym for *Single In-line Memory Module,* a circuit board that contains eight RAM chips. SIMMs attach to SIMM sockets on the computer's main circuit board.

size box: A box at the bottom-right corner of most active windows that lets you resize the window.

software: Programs, or instructions for the computer to carry out. The computer reads these instructions from disks or from ROM.

source: The original, as opposed to the duplicate (or **destination**), in making a copy of a document, folder, or disk.

spooling: In printing or sending a document, the application's ability to create a temporary file for the document and return control of the computer to you while the document is processed in the background. See **background processing.**

startup disk: A disk that contains the system files the computer needs to get itself started. A startup disk must have at least a Finder and a System file. It may also contain files such as printing resources, Scrapbook, and Clipboard.

sticky keys: An Easy Access feature that lets you type combination keystrokes without actually pressing the keys simultaneously. See **Easy Access.**

style: A stylistic variation of a font, such as italic, underline, shadow, or outline.

System file: A file the computer uses to start itself up or to provide system-wide information. Although system files are represented by icons just as documents and applications are, they can't be opened in the usual way. You can, however, alter their contents. For example, you can use the Font/DA Mover to change the contents of the System file. See also **startup disk.**

System Folder: A folder on a disk that includes at least the Finder and the System file—two files the computer needs to start itself up. When you first turn on the computer, the operating system looks in the disk drives for a disk containing a System Folder. The first disk it finds with a System Folder becomes the **current startup disk.**

system software: The set of files and resources in the System Folder that the computer uses to run itself.

Tab key: A key that, when pressed, moves the insertion point to the next tab marker or, in a dialog box with more than one place to enter information, to the next text box.

TeachText: An application on the *Macintosh System Tools* disk that lets you read **plain-text documents.**

terminator: A device used in a SCSI chain to maintain the integrity of the signals passing along the SCSI chain. A SCSI chain should never have more than two terminators, one at each end of the chain. See **SCSI.**

text box: The place or places in any dialog box where you can type information.

3.5-inch disk: A flexible plastic disk measuring 3.5 inches in diameter and having a hard-shell plastic jacket.

title bar: The horizontal bar at the top of a window that shows the name of the window and lets you move it.

track: A portion of a disk's surface. When a disk is first initialized, the operating system divides the disk's surface into circular tracks, with each track divided into sectors. Tracks and sectors are used to organize the information stored on a disk.

Trash: An icon on the desktop that you use to discard documents, folders, and applications.

Update Folder: A folder on the System Tools disk, and on other application and system disks, that contains **Read Me documents.**

user group: A computer club where computer users exchange tips and information, usually about a particular brand of computer.

user interface: See **Macintosh User Interface.**

User Interface Toolbox: Routines in ROM that provide application program developers with templates for windows, dialog boxes, icons, menus, and other standard elements of the **Macintosh User Interface.**

utility program: A special-purpose application that alters a system file or lets you perform some useful function on your files. Examples are the Font/DA Mover and the Installer.

window: An area that displays information on the desktop. You view documents through a window. You can open or close a window, move it around on the desktop, and sometimes change its size, edit its contents, and scroll through it.

word wrap: The automatic continuation of text from the end of one line to the beginning of the next. Word wrap lets you avoid pressing the Return key at the end of each line as you type.

wristwatch: The pointer that you see on the screen when the computer is performing an action that causes you to wait.

write-protect: To protect the information on a disk. You write-protect, or **lock,** a 3.5-inch disk by sliding the small tab in the left corner on the back of the disk toward the disk's edge.

zone: A network in a series of interconnected networks, joined through **bridges.**

zoom box: The small box on the right side of the title bar of some windows. Clicking the zoom box expands a window to its maximum size. Clicking it again returns the window to its original size.

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